Volume 3 21 May 2001 Number 1

The Taxonomic Report

OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# CLARIFICATION OF AND COMMENTS ON NORTHERN *SPEYERIA HYDASPE* SUBSPECIES (LEPIDOPTERA: NYMPHALIDAE)

NORBERT G. KONDLA
Box 244, Genelle, British Columbia V0G 1G0 Canada

**ABSTRACT.** The geographic distribution and use of three northern *S. hydaspe* subspecies names is reviewed. This is necessary due to literature errors about the type locality of subspecies *rhodope* (Edwards, 1874). The correct placement of the *rhodope* type locality renders the name *S. hydaspe sakuntala* (Skinner, 1911) of interior British Columbia as a junior synonym of *S. hydaspe rhodope*. The name *S. hydaspe minor* (McDunnough, 1927) is available for the coastal populations by those who recognize these as different from those of the interior.

**Additional key words:** *gregsoni* Gunder, 1932, *skinneri* Holland, 1931.

## OVERVIEW OF PERTINENT NAMES

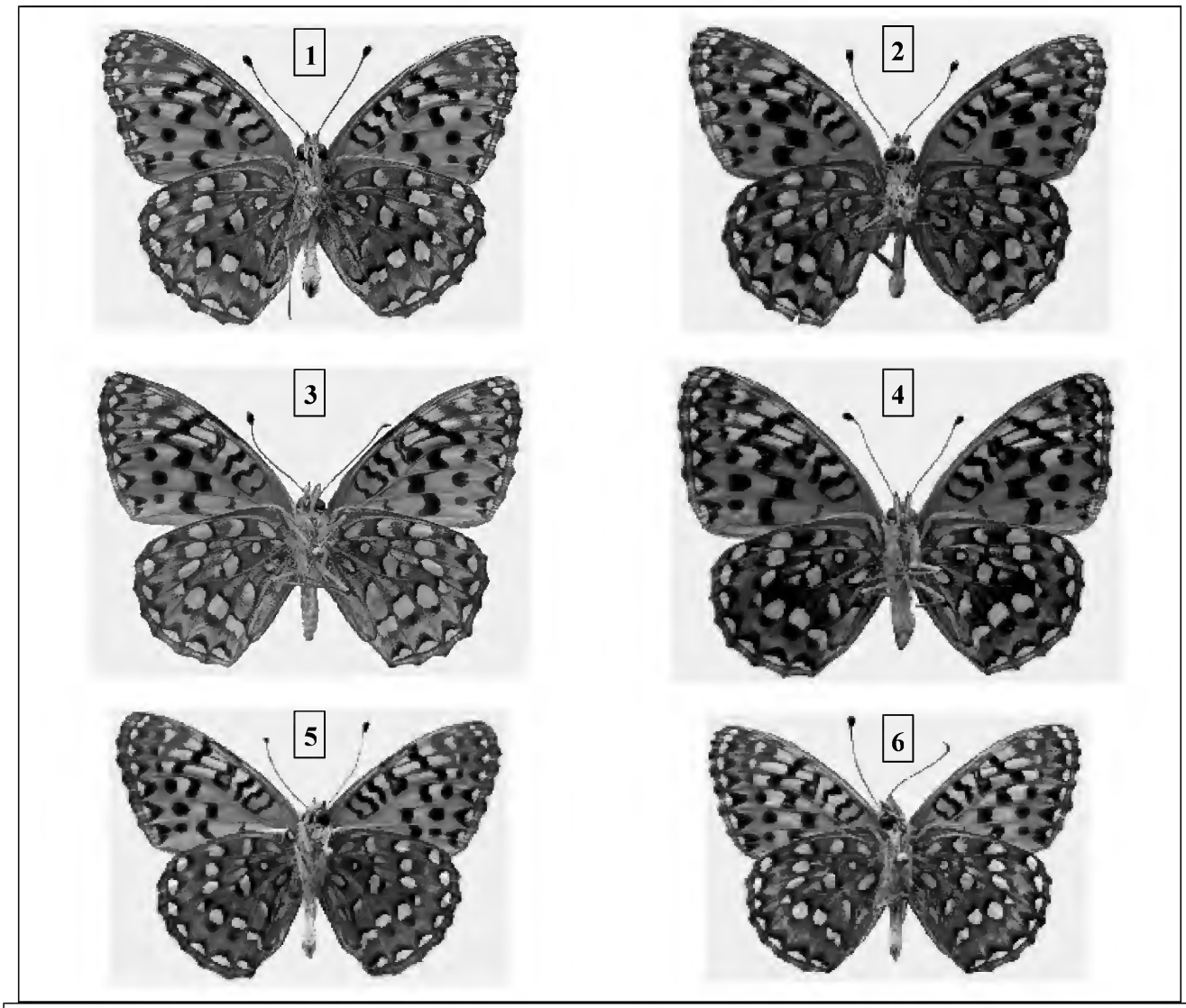
The subspecies name *rhodope* (Edwards 1874) has frequently been used for the *Speyeria hydaspe* (Boisduval, 1869) populations on Vancouver Island and nearby coastal areas of British Columbia (Guppy and Shepard 2001, Howe 1975, Layberry et al. 1998). Dornfeld (1980) viewed *rhodope* as being a butterfly of coastal Washington and British Columbia. Hinchliff (1996) also treated *rhodope* as a coastal taxon. Miller and Brown (1981) and Guppy and Shepard (2001) both use the vague phrase "Fraser River Lowlands" to designate the type locality. Both the distribution noted above and the putative type locality are incorrect.

Edwards (1874) described *rhodope* from three males and one female "taken in British Columbia, in 1873, by G.R. Crotch". Edwards described a butterfly that is deep red fulvous on the dorsum with the basal portions of both wings dark brown. The ventral hind wings were described as deep red. However, Crotch referred to these butterflies as purple. This may be attributable to differing color perception or the effect of viewing under natural versus artificial light. This may also be due to the type series consisting of both the red and purple color morphs mentioned later in this review. The male wing expanse was given as 2.2 inches for the male and as 2.4 inches for the female.

Skinner (1911) described *sakuntala* from four males and one female taken at Ainsworth, BC; Kaslo, BC; and Laggan, Alberta. Skinner does not give a size for *sakuntala* but McDunnough (1927) says that the wing expanse is 2 inches. Skinner unfortunately does not mention the origin of the comparative "*rhodope*" material he used to compare with his new subspecies. So we cannot be certain that he even compared *sakuntala* with *rhodope* in the traditional use of the name. He did mention comparison with a large series of *rhodope* which may have been in the Academy of Natural Sciences of Philadelphia. He also mentioned submitting the specimens for study by C. Gordon Hewitt, Dominion Entomologist in Ottawa, Ontario. Hewitt had access to the butterfly collection that is now referred to as the Canadian National Collection (CNC). The CNC holdings of *S. hydaspe* collected prior to 1911 totaled some 67 specimens; so

Hewitt appears to have had a reasonable amount of material to work with. What is clear, is that Skinner described the red phenotype of the species that flies in the west Kootenay area of southeastern British Columbia. Skinner was candid enough to state: "What relation it bears to *rhodope* in nature can't be foretold, but it is sufficiently distinct to call attention to it in the hope that future study will establish its true relationship".

The level of differences described by Skinner between *sakuntala* and *rhodope* fall within the normal range of variation I have observed from specimens collected near the *sakuntala* type locality. I have examined more than 200 specimens of *sakuntala* from the general area of the type locality and have noted the following: size is variable from small to large; dorsal color is variable from light to dark; ventral hindwing discal area and ventral forewing apical area color comes in two color morphs – red and purple. These color morphs are illustrated in Figures 1 to 4.




**Figs. 1-6: 1-4:** *Speyeria hydaspe rhodope* color morphs (ventral surface); **5-6:** *S. hydaspe minor*. **Fig. 1.** *S. h. rhodope,* ♂: red morph: 31 July 1999, Km 3 Conkle Lake road near Rock Creek, British Columbia. **Fig. 2.** *S. h. rhodope,* ♂: purple morph: 31 July 1999, Km 3 Conkle Lake road near Rock Creek, British Columbia. **Fig. 3.** *S. h. rhodope,* ♀: red morph: 11 July 2000, Km 4 West Erie Forest Service road near Erie Lake, British Columbia. **Fig. 4.** *S. h. rhodope,* ♀: purple morph: 11 July 2000, Km 4 West Erie Forest Service road near Erie Lake, British Columbia. **Fig. 5.** *S. h. minor,* ♂: 24 July 2000, Shorts Creek canyon, near Fintry, British Columbia. **Fig. 6.** *S. .h. minor,* ♂: 4 August 2000, Evelyn Creek, Yalakom Forest Service road, NW of Lillooet, British Columbia. All leg. N. Kondla except 5 & 6 leg. D. Threatful. Photos by N. Kondla. (All specimens natural size.)

McDunnough (1927) described *minor* as an altitudinal infrasubspecific form on the basis of 3 males and two females from Mt. McLean; one male from Lillooet and one male from Anderson Lake, British Columbia. The wing expanse given for *minor* is 1 ¾inches. Dos Passos and Grey correctly attributed authorship of *minor* to McDunnough. I accept this as being compliant with the ICZN provisions on this matter (see Articles 10.2 and 45.6.4.1 of the ICZN fourth edition).

## SYSTEMATIC ANALYSIS OF THESE NAMES

Miller and Brown (1981) gave the type locality of *rhodope* as "Fraser River lowlands" and asserted that this was designated by Brown in 1965. They went on to say that a previous designation by dos Passos and Grey "is rejected". There are significant errors in, and thus systematic problems created by, this view advanced by Miller and Brown (1981). In actuality, Brown (1965) did not designate a type locality. All he said was that "topotypical *rhodope* hails from the forested, broad river bottoms of the Fraser River system". This assertion is categorically incorrect and demonstrates that Brown had an inadequate understanding of the geography and history of British Columbia.

Brown (1965) quotes Edwards in Butterflies of North America that *rhodope* was collected by G.R. Crotch "on the way from Bates (commonly called 100-mile House) to Beaver Lake". Brown asserts that Beaver Lake is about 15-20 miles west of Quesnel Lake. I have confirmed this approximate location of Beaver Lake by checking official British Columbia government geographical information. Crotch stated in a letter to Edwards that "the small *Argynnis* with purple beneath was only found in the forest on the way from Bates's to Beaver Lake". So the type material was collected in the uplands of the Cariboo district, an unknown distance east of the Fraser River along the old trail used to access the Cariboo mining areas. The type locality of *rhodope*, in the words of the collector of the butterflies and in the words of the describer of the subspecies, is therefore some 300-400 kilometres from the coast. There is no evidence whatsoever that the butterflies were collected in the "forested, broad river-bottoms of the Fraser River system" as alleged by Brown (1965). In fact the above evidence prohibits this speculation.

Dos Passos and Grey (1947) designated a lectotype from one of the Crotch specimens and correctly fixed the type locality of *rhodope* as Cariboo District, British Columbia. Article 76.2 of the ICZN (International Code of Zoological Nomenclature) clearly states that: "The place of origin of the lectotype becomes the type locality of the nominal species-group taxon, despite any previously published statement of the type locality." Miller and Brown (1981) did not correctly grasp the type locality of the lectotype, so their "rejection" of the dos Passos and Grey type locality is completely without merit.

McDunnough (1927) also correctly identified the type area as being along the old Cariboo trail at about 2500 feet elevation. The Cariboo Wagon Road was built in the years 1862-1864 and was the route to access the Cariboo gold fields. It is an upland road that did not get into the "lowlands" of the Fraser River. He correctly points out that *sakuntala* is a variable form and that Skinner's "points of distinction do not always hold". Further, he thought that *minor* would probably be found "all throughout the Cascade and Coast ranges at suitable elevations" and also observed that Vancouver Island material "may possibly be slightly darker in color".

This leaves us in a situation where the official type locality of subspecies *rhodope* is within the range of subspecies *sakuntala* as mapped by Guppy and Shepard (2001). The subspecies *sakuntala* (Skinner, 1911) therefore falls as a junior synonym of *rhodope* Edwards, 1874. If there is a *bona fide* subspecies difference between the coastal and interior populations; then this at first glance leaves the coastal populations without a subspecies name. But the name *minor* (McDunnough, 1927) is available to apply to the coastal populations until such time as future study presents a convincing case for taking a different approach. Some individuals may chose to simply treat all of the northern populations as subspecies *rhodope* as was done by Scott (1986). However, subspecific differences between coastal and

interior butterflies are the norm in this region rather than the exception. Thus, I am reluctant to simply consider all these populations as taxonomically the same.

An examination of a small series of coastal specimens suggests that the coastal populations of British Columbia may merit recognition as a separate subspecies from *rhodope* of the interior. The primary points of distinction appear to be a darker dorsum, especially darker wing basal areas, and a distinctly maroon color to the ventral hindwing. A typical specimen of *minor* is illustrated in Figure 6. However, butterflies fitting the maroon ventrum phenotype also occur as far east as the west side of the Okanagan valley (Figure 5) and even into southeastern British Columbia as evidenced by the specimen used to illustrate *sakuntala* in Guppy and Shepard (2001).

At present it seems best to view *minor* as occupying the south coastal area of British Columbia and extending an unknown distance into the interior. Note however that none of the three ventral views of *S. hydaspe* specimens illustrated by Guppy and Shepard (2001) show the ventral colors that are congruent with the respective original descriptions of the names attached to the illustrations. I have only seen the red ventrum phenotypes from southwestern Alberta.

There are two final names that warrant brief mention. The taxon *gregsoni* (Gunder 1932) was described as a transitional form from one melanic female collected on Mt. Washington, Vancouver Island. It has been consistently and correctly recognized as an infrasubspecific entity (dos Passos and Grey 1947, dos Passos 1964, Miller and Brown 1981) since it was described. The only point of clarification needed is that the name is associated with the taxon *minor* and is not associated with *rhodope*, unless, of course, one lumps all BC populations under *rhodope*. The taxon *skinneri* (Holland 1931) was proposed as a replacement name for *sakuntala*, wrongly thought to be preoccupied. It should be placed in the synonymy of *rhodope* rather than its traditional location in the synonymy of *sakuntala.*

Of course this entire discussion is predicated on the assumption of a nominal species *S. hydaspe* in this part of North America. I am not aware of any rearing studies to show that the phenotypic variation described herein is in fact variation within one species. Phenotypic variation within populations presently mapped as one subspecies in Guppy and Shepard (2001) exceeds the differences between some named subspecies in California (Emmel 1998, Howe 1975). Thus, rearing and breeding studies should be undertaken. If these have already been done, the results should be published.

## CONCLUSION

The coastal populations that are called *rhodope* in Guppy and Shepard (2001) are not such because 1) the type locality is some hundreds of kilometres from the nearest population of *rhodope* as mapped in their book and because 2) the coastal putative *rhodope* populations are separated from the type locality by populations of subspecies *minor*. The subspecies name *minor* is available for application to the areas mapped as *rhodope* and *minor* in Guppy and Shepard (2001) and the name *rhodope* definitely applies to the areas mapped as *sakuntala* in the same book. The name *rhodope* could also be justifiably used for all British Columbia populations since nobody has ever demonstrated that there are reasonably consistent differences between coastal and interior populations.

Field work is needed to document the distribution of the ventral color morphs in southern British Columbia. It should not be too difficult to eventually accumulate adequate study material because this butterfly does not have the most limited distribution of any *Speyeria* in BC as alleged by Guppy and Shepard (2001). Rather the maps in said book clearly show that it is the second most widespread *Speyeria* in the province. Rearing and examination of gene chemistry may be needed to determine if the variation described herein has any taxonomic significance. The taxonomy of *S. hydaspe* in Alberta and British Columbia should be reassessed once this work has been completed.

---

## ACKNOWLEDGEMENTS

I thank Ron Gatrelle and Crispin Guppy for reviewing drafts of this paper. David Threatful shared study specimens. John Calhoun assisted with access to literature. J. Donald Lafontaine provided historical information on C. Gordon Hewitt. Annabelle Jessop provided data on *S. hydaspe* specimen holdings of the Canadian National collection.

## LITERATURE CITED

BROWN, F.M. 1965. The Types of the Nymphalid Butterflies Described by William Henry Edwards. Part I. Argynninae. Transactions of the American Entomological Society 91:233-350.

DORNFELD, E.J. 1980. The Butterflies of Oregon. Forest Grove, Oregon: Timber Press. 276 pp.

DOS PASSOS, C.F. 1964. A Synonymic List of the Nearctic Rhopalocera. *Lepidopterists' Society Memoir* No.1. 145 pp.

DOS PASSOS, C.F. and L.P. GREY. 1947. Systematic Catalogue of *Speyeria* (Lepidoptera, Nymphalidae) with Designation of Types and Fixations of Type Localities. American Museum Novitates No. 1370. 30 pp.

EDWARDS W.H. 1874. Descriptions of New Species of Diurnal Lepidoptera Found in North America. Transactions of the American Entomological Society 5:13-19.

EMMEL, T.C. (ed.). 1998. Systematics of Western North American Butterflies. Gainesville, Florida: Mariposa Press. 878 pp.

GUNDER, J.D. 1932. New Rhopalocera (Lepidoptera). Canadian Entomologist 64:276-284.

GUPPY, C.S. and J.H. SHEPARD. 2001. Butterflies of British Columbia.Vancouver: UBC Press. 414 pp.

HINCHLIFF, J. 1996. The Distribution of the Butterflies of Washington. Corvallis, Oregon: The Evergreen Aurelians. 162 pp.

HOLLAND, W.J. 1931. The Butterfly Book. Rev. ed. Garden City, NY: Doubleday. 424 pp.

HOWE, W.H. 1975. (Editor) The Butterflies of North America. Doubleday and Co., Inc. 632 pp.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE. 1999. International Code of Zoological Nomenclature, Fourth Edition (1 January 2000). London, UK: The International Trust for Zoological Nomenclature. 306 pp.

LAYBERRY, R. A., P. W. HALL and J. D. LAFONTAINE. 1998. The Butterflies of Canada. Toronto: University of Toronto Press. 280 pp.

McDUNNOUGH, J.H. 1927. The Lepidoptera of the Seton Lake region British Columbia. Canadian Entomologist 56:152-162.

MILLER, L.D. and F.M. BROWN. 1981. A Catalogue/Checklist of the Butterflies of America North of Mexico. Memoir no. 2. The Lepidopterists' Society 280 pp.

SCOTT, J.A. 1986. The Butterflies of North America: A Natural History and Field Guide. Stanford, California: Stanford University Press, 583 pp.

SKINNER, H. 1911. A new *Argynnis* and a new *Parnassius* (Lep.). Entomological News 22:108.

---

**The Taxonomic Report**

is a publication of ***The International Lepidoptera Survey (TILS).***

(A Tax Exempt Non-Profit Scientific Organization )

***The Taxonomic Report*** is projected for publication at the rate of 8-10 issues a year. Subscription/ dues for Volume Three are $45 US for domestic and $55 US for overseas subscribers. The subscription year follows the calendar year. All issues are mailed 1st class. At the end of each year, subscribers receive that year's volume on a record-only compact disc (CDR) for permanent archiving and reproduction for personal use (i.e. a museum or university may make as many copies as needed in whatever format desired). Non-members may receive individual issues in print any time for $10 per issue. Individual issues on CDR to non-members are $25 per issue post paid. **Subscriptions** and **individual issue** orders should be made payable to **TILS;** and **mailed to:** Treasurer, 126 Wells Road, Goose Creek, SC USA 29445-3413.

Volume 3 5 June 2001 Number 2

The Taxonomic Report
OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# AN EXAMINATION OF SOUTHEASTERN U.S. *SATYRIUM* (LYCAENIDAE: THECLINAE).
## PART ONE:
## AN OBSCURE NEW SUBSPECIES OF *SATYRIUM EDWARDSII*

RONALD R. GATRELLE[1]
126 Wells Road, Goose Creek, South Carolina 29445-3413

**ABSTRACT.** *Satyrium edwardsii meridionale* is described as a new subspecies from Aiken County, South Carolina. This scarce colony is the southeasternmost known population of this butterfly in the United States. It was discovered by the author in 1990 near Aiken State Park in Aiken County, South Carolina. This site is in South Carolina's upper Coastal Plain in the southern part of the state adjacent to Georgia. It is known from only one male and one female at the type locality. Because it was known from only one pair, the author thought it best to wait until more specimens became available before describing this as a new subspecies. In 2000 the author located a series of several very similar *edwardsii* from Cobb County, Georgia in the FSCA collection Gainesville, Florida. Also, in recent years populations of *S. edwardsii* have been discovered in the southern Sandhills (upper Coastal Plain) of North Carolina that may well prove to belong to this subspecies as well. This was seen as sufficient evidence to confirm the southernmost populations as a phenotypically distinct subspecies paralleling the normal subspecific pattern of all other eastern U.S. *Satyrium* of northern and southern clinal subspecies. Compared to the nominate subspecies, *meridionale* is much larger, has bolder marking on the ventral hindwing margins, much longer tails and the spots of the postmedian band tend to be less round. It is sympatric with *Satyrium calanus* nr. *falacer*, *Satyrium liparops liparops*, *Satyrium titus mopsus*, and two other undetermined and/or undescribed *Satyrium* species or subspecies at the type locality. The holotype is currently deposited in the *Museum of the Hemispheres* collection, Goose Creek, South Carolina, USA.

**Additional key words:** Ancient populations, relict refugium species, biogeographical evolution.

## ORIGINAL DESCRIPTIONS

In 1867 Grote and Robinson published an article in the Transactions of the American Entomological Society titled *Descriptions of American Lepidoptera – No. 2.* In this they describe two new hairstreak butterflies under the names *Thecla lorata* and *Thecla henrici*. Their *henrici* is what we know today as *Deciduphagus henrici* (Grote and Robinson, 1867). Their *lorata* has always been placed in the synonymy of *Satyrium calanus* (Hübner, 1809). In their treatment of *lorata* they compare it against "*Thecla calanus*". The problem here is that what they call *lorata* is actually what we know today as *Satyrium calanus falacer* (Godart, 1822), and what they call *calanus* is what we know today as *Satyrium edwardsii* – as traditionally attributed to Grote and Robinson per this 1867 paper.

There are serious problems with the Grote and Robinson article relative to the name *edwardsii,* primarily because *edwardsii* was not actually described in this paper. What they gave was clearly intended as a redescription of Hübner's *calanus,* which they misunderstood. The name *edwardsii* was mentioned only twice in this paper. First, in Grote & Robinson's list of *calanus* synonyms, and second as an anecdotal

[1] Research Associate, Florida State Collection of Arthropods, Gainesville, Florida.

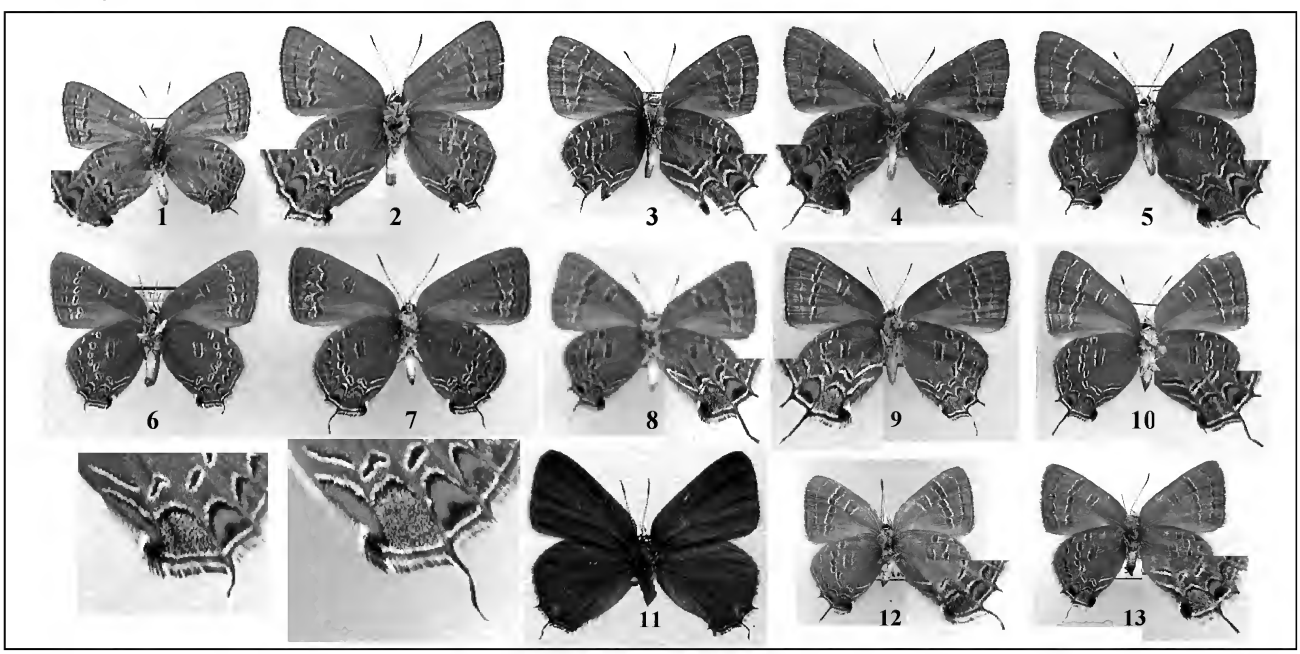
aside relative to an (at the time) unpublished manuscript name of Saunders. Two years later Saunders published this name himself in The Canadian Entomologist (1869) – where he likewise sank it as a *calanus*. In this paper, Grote and Robinson only give a semi-redescription of *calanus* (as compared to their *lorata*) based on two *nomen dubium* specimens from Mr. Saunders. These two specimens (at least the male) are likely what we have come to know as *edwardsii*. I say likely, as there are one or two other undescribed eastern U.S. *Satyrium* that Saunders may have had in hand. These have red antennal clubs in females (as did the Saunders' female) and/or expanded orange at the hindwing anal angle (Figs. 4 & 9).

Some of these problems were recognized by Michener and dos Passos, who, in 1942 reviewed this situation and designated a neotype which they deposited in the American Museum of Natural History, New York. (I have not had the opportunity to examine the neotype.) In their paper, Michener and dos Passos attribute the name *edwardsii* to Grote and Robinson. This, however, is contrary to the International Code of Zoological Nomenclature Articles 11, 12.2, 12.2.1 and 12.3. Michener and dos Passos' attribution of *edwardsii* is stated as follows.

The specific name *edwardsii* has usually been credited to Saunders. Apparently it was first used in print by Grote and Robinson (1867) who credited it to Saunders, saying that it was to their knowledge previously unpublished, and placing it as a synonym of *calanus*. As shown by Scudder (1870) the *calanus* of Grote and Robinson was the species now called *edwardsii*. Their placement of the name *edwardsii* under their *calanus* is as definite an indication of the species involved as a bibliographic citation, and hence the name *edwardsii* was nomenclatorially validated by and must be credited to Grote and Robinson, as stated by Barnes and Benjamin (1926, Bull. So. Calif. Acad. Sci., XXV, p. 94).

Saunders in 1869 was the next to use his name *edwardsii*, and he also placed it as a synonym of the *calanus* of Grote and Robinson.

Finally Scudder in 1870 realized that *calanus* Grote and Robinson was not *calanus* Hübner and proposed to call the former *edwardsii* Saunders. It was Scudder who first clearly stated the characters of *edwardsii*, and the species might reasonably be credited to him.




**Figures 1-13.** *Satyrium* species. **Fig. 1.** ♂ *S. e. edwardsii*: 7 July 1993, Jones Gap, Macon Co., NC. **Fig. 2.** Holotype ♂ *S. e. meridionale*: 1 June 1990, Aiken Co., SC. **Fig. 3.** ♂ *Satyrium* undescribed: 21 May 1977, Aiken Co., SC. **Fig. 4.** ♂ *Satyrium* undescribed: 19 June 1976, Aiken Co., SC. **Fig. 5.** ♂ *S. calanus falacer*: 17 May 1991, Aiken Co., SC. **Fig. 6.** ♀ *S. e. edwardsii*: 8 July 1973, Sherborn, MA. (leg. Winter). **Fig. 7.** Allotype ♀ *S. e. meridionale*: same data as fig. 2. **Fig. 8.** ♀ *Satyrium* undescribed: same data as fig. 3. **Fig. 9.** ♀ *Satyrium* undetermined/undescribed: 21 May 1977, Aiken Co., SC. **Fig. 10.** ♀ *S. calanus falacer*: same data as fig. 5. **Fig. 11.** Paratype ♀ *S. e. meridionale*: Cob Co., GA. (leg. Towers). **Fig. 12.** ♀ *S. caryaevorum*: 6 July 1993, Jones Gap, Macon Co., NC. **Fig. 13.** ♀ *Satyrium* undetermined: same data as fig. 12 except 7 July. All leg R. Gatrelle except 6 & 11. All specimens actual size. Photos by Joe Mueller. (The short tails on Fig. 11 are an optical illusion. They droop downward on the mounted specimen, and are as long as those of Fig. 7.)

The key phrase here by which they attribute the name is "...as definite an indication of the species involved as a bibliographic citation..." The error here is that there can be no "bibliographic citation" where there is no valid publication to cite (12.2.1). The fact that Grote and Robinson had an actual Saunders specimen in hand is disallowed by 12.3 as a mechanism of validation. *Edwardsii* Grote and Robinson is a *nomen nudum* and thus not an available name from either Saunders, or Grote and Robinson 1867.

In 1869 Saunders published this name himself. However, he gave no description, and established no type. He simply gave it as a Synonymic listing under *calanus* – this would not seem to meet the rules of availability (Articles 10-20). Scudder, as pointed out by Michener and dos Passos themselves, in 1870 was the first to actually fully describe and illustrate *edwardsii*. His action validated the name to his authorship and date (see ICZN Glossary under *nomen nudum*). Thus, the correct nomenclatorial citation is *Satyrium edwardsii* (Scudder, 1870).

## NORTHERN NOMINATE *EDWARDSII*

The name *Satyrium edwardsii* was affixed by the Michener and dos Passos' neotype to populations in southeastern Canada, type locality Queenstown, Ontario. The male specimen Grote and Robinson had in hand was also listed as from Canada. The female in Grote and Robinson's possession in 1867 was from Philadelphia, Pennsylvania. I do not think this specimen was what we now call *edwardsii* because they stated that the underside of the antennal club was "fulvous beneath." I have not observed this feature in *edwardsii*. I have collected specimens of a "falacer" in Iowa with ventrally very orange clubs in the female.

Nominate *edwardsii* is a smallish, short tailed taxon. The nominate subspecies' range extends from Canada into the New England states and down the Appalachian Mountains, in this typical form, to extreme southwestern North Carolina (Fig. 1). I have personal experience with nominate *edwardsii* in Macon County, North Carolina at Jones Gap between 3800 to 4200 ft. elevation. Macon County abuts Rabun County, Georgia and Oconee County, South Carolina.

Layberry et al (1998) states that the larval hosts of nominate *edwardsii* in southeastern Canada are Black Oak (*Quercus velutina* Lam.), White Oak (*Q. alba* L.) and Red Oak (*Q. rubra* L.). Gochfeld and Burger (1997) list Scrub Oak (*Q. ilicifolia* Wang.) as the primary larval host in New Jersey with Black Oak as a possible host. Allen (1997) also lists *Q. ilicifolia* as the primary host for West Virginia, but adds that Black Jack Oak (*Q. marilandica* Muenchh.) is also used there. Of these known hosts, only *ilicifolia* is not known from the southern Appalachian Mountains of North Carolina, Georgia, and South Carolina. However, since Black, White, and Red oaks are not primary larval hosts in the northern Appalachians of West Virginia or the coastal state of New Jersey, *marilandica* is the only frequently utilized northern U.S. *edwardsii* host that also occurs in the southern Appalachian area.

## SOUTHERN NON-MONTANE *EDWARDSII*

Specimens of *edwardsii* from the deep South have rarely been encountered. One of the main reasons for this is, undoubtedly, the historical lack of collectors in the South. Nevertheless, this species is probably truly rare in the coastal region of the South from South Carolina westward. Harris (1972) gives several records from throughout the Piedmont region of Georgia, with the southern most being in Bibb County on the edge of the upper coastal plain. While Harris lists *Q. ilicifolia* as a host, he was surely only repeating this as referenced in the literature to northern populations as this tree does not occur in Georgia. It is interesting that one of his locations is at Blackjack Mountain (Cobb County) which is very probably named after the Black Jack Oak – which is a known *edwardsii* host in West Virginia and coastal North Carolina.

On 1 June 1990, while collecting specimens of various *Satyrium* species near the southern boundary of Aiken State Park, in Aiken County, South Carolina, I was surprised to find a courting pair of *Satyrium edwardsii* (Figs. 2 & 7). This area is part of the Sandhills region of North Carolina, South Carolina and Georgia in the upper coastal plain of these states. This particular location is only 27 miles from the Georgia line at the Savannah River and 30 miles from the lower coastal plain region of South Carolina. The area where this pair was taken is at the junction of two habitats. They were collected in dry sandhill habitat but less than 100 yards from where there is a dramatic shift to the wet Edisto River basin. The sandhill area is dominated by Turkey Oak (*Quercus laevis* Walter). However, there is also a good bit of Black Jack Oak in this immediate area.

It was apparent immediately that this pair was very large and phenotypically distinct from northern nominate *Satyrium edwardsii*. I looked further that day and again the next year but located no further specimens in that general area. In 1999 this area began to be developed into residential acreage. Today, in 2001, the literal spot of collection is in tact but the surrounding immediate area is largely decimated.

With the increase in popularity of butterfly watching, several healthy populations of *S. edwardsii* have now been discovered in the North Carolina upper coastal plain (Scotland, Moore and Cumberland counties) adjacent to South Carolina. Unfortunately, I know of no specimens that have been collected from these taxonomically important populations. The prevailing attitude among many butterfly watchers (at least in the eastern US) is apparently that all butterfly species and subspecies have been discovered and thus there is no need for any more scientific (or recreational) collecting. This is not the true. These populations need to be collected in long enough series to determine their taxonomic status. They may be too far "north" to be the new subspecies described herein, however, they are definitely too far "south" to be nominate *edwardsii*. They are either the new subspecies (which is very likely) or a blend zone phenotype nr. the new subspecies.

In 2000 while researching other taxa, I came across a series of nine *edwardsii* collected in Cobb County, Georgia. These were obviously not nominate *edwardsii*. Most were identical to the Aiken phenotype, but a couple were somewhat atypical in size. I borrowed these and gave them, and this whole situation, a lot of thought.

## DESCRIPTION OF A NEW *EDWARDSII* SUBSPECIES FROM THE DEEP SOUTH

Clinal subspecies are the most common but, generally, they are also the least evolutionarily distinct. *Satyrium calanus calanus* and *calanus falacer* (Godart, [1824]), *S. liparops liparops* (LeConte, 1833) and *liparops strigosum* (Harris, 1862), *S. titus titus* (Fabricius, 1793) and *titus mopsus* (Hübner, 1818), and *Fixsenia favonius favonius* (J.E. Smith, 1797) and *favonius ontario* (W.H. Edwards, 1868) are all well established, and almost universally accepted, north/south clinal hairstreak subspecies pairs in eastern North America. It is therefore not only not surprising but to be expected that *Satyrium edwardsii* follows this same pattern in eastern North America.

While no other records exist for *edwardsii* in coastal South Carolina, the several records from Georgia and coastal North Carolina leave no doubt that *edwardsii* is a breeding resident in the deep South. The lack of discovery of additional colonies in this area is just that – a lack of discovery due to few historical workers in this region. Now that this taxon is being recognized as a distinct subspecies, this will doubtless spur more interest in it, and inevitably, the discovery of more colonies in the South. My opinion is that it is an uncommon to rare component of the fauna of the deep South and should be considered as a candidate for special attention by wildlife agencies – though far from threatened or endangered. The type locality is already largely destroyed by housing and ranching development.

The Sandhills as a whole are massive and thus an enormous area of suitable habitat exists in which this taxon may very well occur. I have located one area in Orangeburg County, South Carolina in particular that looks promising in regard to the discovery of this new taxon there. Five other *Satyrium* have already

been found there plus a rare and unusually marked colony of *Fixsenia favonius* that is definitely not the nominate subspecies and may represent the southern most known colony of subspecies *ontario* (W.H. Edwards, 1868)

Kimble (1965) mentions three *edwardsii* specimens in the American Museum of Natural History labeled from Florida and collected by Palm. One is labeled "Kissimmee". This is in the Orlando area and is well into peninsular Florida. John Calhoun (1997) examined these specimens and has determined that they are typical of northern nominate *edwardsii* and that they are surely mislabeled. If *edwardsii* was to occur in Florida, the panhandle would be the most likely area. It would also be the new subspecies described herein.

## *Satyrium edwardsii meridionale* Gatrelle, new subspecies

**Diagnosis and description.** The male (Fig. 2) and female (Fig. 7) of *meridionale* are marked much alike. **Dorsally**, most *Satyrium edwardsii edwardsii* and *S. edwardsii meridionale* are virtually identical. The only difference being the size and frequency of the red spot on the hindwing margin at the tail (Fig. 11). Two of the three known females of *meridionale* have this spot, but it is small and faint. All 8 male *meridionale* have this spot but it is likewise very small and faint. In nominate *edwardsii* this spot is not always present but is commonly very prominent, especially in females. **Ventrally**, nominate *edwardsii* has the postmedian band consistently formed of distinctly round or ovoid spots with prominent white outlines. In *meridionale* these spots are ovoid to connected bars and are not as prominently outlined with white, especially on the forewings. Typical of, and consistent with, southern *Satyrium* subspecies, the markings along the outer margin of the hindwings of *meridionale* are enlarged, elongated and thus have bolder red-orange marking in this area. The tails are nearly twice as long on *meridionale* as in *edwardsii* for both sexes (unfortunately the tails are missing on the holotype). The wing expanse of mounted specimens of nominate *edwardsii* varies from 20 to 30 mm. (small males to large females). In the *meridionale* type series the expanse ranges from 26 to 35 mm. (small male to largest female). *Meridionale* basically averages 5 mm. larger in each sex – which is quite a bit for a small species. Summation of *meridionale* characters: large size, frequent but faint marginal red spot on DHW, spots of ventral postmedian bands tending to become bars and less boldly outlined with white, very long tails, expanded red and larger spots on VHW margin, VHW blue spot tending to have prominent gray-blue inner cap. The male stigma of *edwardsii* (including *meridionale*) is much narrower than the stigma of either *calanus* or *caryaevorum* and serves as the best character to separate males of these taxa when their postmedian VHW bands are atypical.

**Types.** *Holotype* ♂ (Fig. 2): SOUTH CAROLINA: Aiken County, along south boundary of Aiken State Park, 1 June 1990 (leg. R. Gatrelle). *Allotype* ♀ (Fig. 7): SOUTH CAROLINA: Aiken County, along south boundary of Aiken State Park, 1 June 1990 (leg. R. Gatrelle). *Paratypes*: 7♂♂, 2♀♀: All GEORGIA: Cobb County, Pine Mountain various dates: 4♂♂, 1♀, 10 June 1973; 1♂, 30 May, 1977; 1♂, 2 June, 1♂, 1♀, 5 June 1979. All paratypes leg. A Towers. The holotype and allotype are currently deposited in the Museum of the Hemispheres, Goose Creek, SC. All paratypes are deposited in the Florida State Collection of Arthropods, Gainesville, Florida.

**Etymology.** *Meridionale* is a neuter latinization meaning characteristic of the south or southern. Its common name is Sandhill Hairstreak.

**Remarks.** It must be remembered that the further south one goes below New Jersey that the ranges of *edwardsii* and *meridionale* shift in opposition from north - south to west - east. I have examined all the *edwardsii* specimens in the FSCA Gainesville and the MOTH collection here in Goose Creek. Some of the more pertinent specimens are from Massachusetts, Missouri and New Jersey. Massachusetts specimens are typical *edwardsii* in size and markings. A series from Oak Ridge, New Jersey are beginning to show an inclination to *meridionale* in that some are larger – though not as large as *meridionale*. The postmedian spots on these New Jersey specimens are still very round and their tails on the short side. I would still refer to these as the nominate subspecies and not a blend zone population. The blend zone will be in Virginia and/or North Carolina east of the mountain region of those states. I also expect the blend zone in the coastal area of those states to be rather large. This remains to be determined and I would be happy to receive specimens (and return them) to help assess where this area is. It is my expectation that the populations in the North Carolina Sandhills near South Carolina will be referable to *meridionale* but this remains in question. Missouri specimens are typical of *edwardsii* in the western part of its range. They are larger than typical Canadian and Appalachian specimens, but are very characteristically marked and with shorter tails. True *meridionale* is strictly a taxon of the deep South. Intermediate populations should be referred to as nr. (near) *edwardsii* or nr. *meridionale* whichever is more appropriate for a given area. I am not entirely comfortable with the series from Cobb County. Both females paratypes from there are very large as are most of the males. But one male is atypically small. Specimens in this area are certainly near the northern edge of *meridionale's* range.

## DISCUSSION

As stated earlier, clinal subspecies are usually the least evolutionarily distinct. While it is clear that *S. edwardsii meridionale* is a clinal subspecies, its geographical location in the Sandhills region indicates evolutionary significance as well. Twenty million years ago, this area was the coast of southeastern North America before the current lower coastal plain was geologically formed. The sands of the Sandhill region were once dune and beach deposits. While the area of central Florida is often referred to in lit as a refugium area from which various unique taxa arose during times of glacial retreat and advance, the Sandhills region is a much older area that provided the same type of evolutionary opportunity. Indeed there remain today a few butterflies that are still endemic to this region of origin. They are *Neonympha mitchellii francisi,* Parshall & Kral, 1989, *Neonympha helicta helicta* (Hübner, 1806), *Chlosyne ismeria ismeria* (Boisduval & LeConte, 1833), *Chlosyne gorgone gorgone* (Hübner, 1810), and *Poanes aaroni minimus* Gatrelle, 2000. In addition, the *Satyrium* that are sympatric with *meridionale* at its type locality exhibit morphological characters that seem to point to the possibility that this area was the evolutionary origin of the eastern North American Banded Hairstreak group of *Satyrium* species.

A coworker and I are in the process of working out just what these other entities at the *meridionale* type locality are. One is what we currently understand to be *calanus* nr. *falacer* (Figs. 5 & 10). The other two may be forms of one variable undescribed species – or, one an undescribed southern subspecies of *Satyrium caryaevorum* (McDunnough, 1942) (Figs. 3 & 8) and the other an undescribed species that is the (or a) link to the ancient ancestor of all three of these taxa (Figs. 4 & 9). It should also be mentioned that *S. titus mopsus* and *S. liparops liparops* are sympatric with these other *Satyrium* at the type locality and that *Satyrium kingi kingi* (Klots & Clench, 1952) has a colony one mile from the type locality in the Edisto River basin.

The undescribed species at this site is of special interest here as many specimens of it have the red bar at the anal angle expanded to almost as prominent as in species *edwardsii* (see enlarged insets on Figs. 4 & 9). Also, as mentioned in the description above, one of the distinguishing characters of *meridionale* is the tendency of the ventral postmedian band to be composed of dashes and away from spots as in nominate *edwardsii*. All of which points to the phenotypic evolutionary closeness of all the taxa at this site.

A few other unusual taxa occur here most notably: *Atrytone arogos arogos* (Boisduval & LeConte, 1852) (only known South Carolina colony), *Lycaena phlaeas americana* Harris, 1862, and the southern subspecies of *Mitoura hesseli* Rawson & Ziegler, 1950 (in press)(only known South Carolina colony). None of these occur in Aiken State Park but are all found immediately outside of it on private property. Thus, unless steps are taken to protect these unusual populations they are all at severe risk of destruction via development. It is also the type locality of *Neonympha helicta helicta* by way of neotype designation.

I think it is very likely that the range of *meridionale* will eventually be determined to extend from the southern sandhills of North Carolina south through this region in South Carolina and Georgia, then westward through the similar Black Belt region of Alabama and Mississippi to southeast coastal Texas. However, it may not extend westward beyond the Mississippi River valley.

## ACKNOWLEDGMENTS

I thank Don Lafontaine for copies of old literature and David Wright and Harry Pavulaan for their input.

## LITERATURE CITED

ALLEN, T.J. 1997. The Butterflies of West Virginia and Their Caterpillars. Univ. of Pitts. Press, Pittsburgh, 388 pp.

CALHOUN, J.V. 1997. Updated List of the Butterflies and Skippers of Florida (Lepidoptera: Papilionoidea and Hesperioidea). Holo. Lepid. 4 (2), pp. 39-50. Gainesville, Florida.

GOCHFELD, M. & J. BURGER. 1997. Butterflies of New Jersey – A Guide to Their Status, Distribution, Conservation, and Appreciation. New Brunswick: Rutgers Univ. Press, 327 pp.
GROTE, A.R., & C.T. ROBINSON. 1867. Descriptions of American Lepidoptera, No. 2. Trans. of the Amer. Ent. Soc. 1 (2): 171-192.
HARRIS, L., Jr. 1972. Butterflies of Georgia. Univ. of Okla. press, Norman OK. 326 pp.
LAYBERRY, ROSS A., PETER W. HALL & J. DONALD LAFONTAINE. 1998. The Butterflies of Canada. Univ. of Toronto Press, Toronto, Canada, 279 pp.
MICHENER, C.D. & C.F. DOS PASSOS. 1942. Taxonomic Observations on Some North American *Strymon* with Descriptions of New Subspecies (Lepidoptera: Lycaenidae). Amer. Mus. Nov. (1210). American Museum of Natural History, New York, 7 pp.

---

## *The Taxonomic Report*

is a publication of ***The International Lepidoptera Survey (TILS).***
(A Tax Exempt Non-Profit Scientific Organization )

***The Taxonomic Report*** is projected for publication at the rate of 8-10 issues a year. Subscription/ dues for Volume Three are $45 US for domestic and $55 US for overseas subscribers. The subscription year follows the calendar year. All issues are mailed 1st class. At the end of each year, subscribers receive that year's volume on a record-only compact disc (CDR) for permanent archiving and reproduction for personal use (i.e. a museum or university may make as many copies as needed in whatever format desired). Non-members may receive individual issues in print any time for $10 per issue. Individual issues on CDR to non-members are $25 per issue post paid. **Subscriptions** and **individual issue** orders should be made payable to **TILS;** and mailed to: **Treasurer, 126 Wells Road, Goose Creek, SC USA 29445-3413.**

**Articles for publication are sought.** They may deal with any area of taxonomic research on Lepidoptera. Before sending a manuscript, simply write **TILS** at the above address to set up discussion on how to best handle your research for publication.

---

Everyday around the world, in jungles and urban areas alike, insect species and subspecies are becoming extinct. Every year scores of taxa are lost that have not even been scientifically discovered and documented. Thus, their extinction is unnoticed because their existence is unknown. They are unknown simply because they have not been collected and systematically identified. Without systematic taxonomy there is nothing. Without the collection, and exchange of specimens (information) there will be no systematic taxonomy. Without amateur collectors the majority of the undiscovered species/subspecies will vanish before they are discovered. Be it butterflies or moon rocks, collecting is the first step of access to all other scientific information – and protection.

**Donations are needed to support and further our efforts to discover and protect butterflies worldwide. All donations are US tax deductible. Please help generously.**
Donations should be mailed to: **Treasurer, 126 Wells Rd., Goose Creek, SC 29445.**
Checks should be made payable to: **TILS.** Please indicate if you need an individual receipt.

Catch us on the web at: **www.tils-ttr.org**

Volume 3 5 July 2001 Number 3

The Taxonomic Report

OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# AN EXAMINATION OF SOUTHEASTERN U.S. *SATYRIUM* (LYCAENIDAE: THECLINAE).
## PART TWO:
## THE IDENTIFICATION AND DELIMITATION OF NOMINATE *SATYRIUM LIPAROPS* AND THE DESCRIPTION OF A NEW SUBSPECIES FROM WEST CENTRAL PENINSULAR FLORIDA.

RONALD R. GATRELLE[1]
126 Wells Road, Goose Creek, South Carolina 29445-3413

**ABSTRACT.** The name *Satyrium liparops liparops* has traditionally been applied to all *liparops* populations from eastern Georgia southward. This tradition is shown to be in error. The type locality of nominate *liparops* is restricted by original description to Screven County, Georgia. A neotype is designated from Screven County and deposited in the MOTH collection Goose Creek, South Carolina. The range of nominate *liparops* is projected to be from coastal South Carolina across the far southern United States (including the Florida panhandle) and into Texas. The population in west central peninsular Florida is described as new subspecies *Satyrium liparops floridensis* type locality Withlacoochee State Forest, Citrus County, Florida. The *floridensis* holotype is deposited in the MOTH collection Goose Creek, South Carolina. Specimens from Alachua County, Florida, to southeast Georgia are intermediate to these two subspecies. *Satyrium liparops floridensis* always has medium to large yellowish burnt-orange patches on the forewings in both sexes. The forewing patch on *liparops liparops* is red-orange and varies from fairly large to none, with most specimens having no patch. Both southern subspecies have long tails. The ventral ground color in *S. l. floridensis* is deep chocolate brown in both sexes. In *S. l. liparops* the ventral ground color is medium to dark brown in males and somewhat lighter in females. This coloration is as it occurs in fresh specimens.

**Additional key words:** *Satyrium liparops aliparops*, *Satyrium liparops strigosum*, step cline.

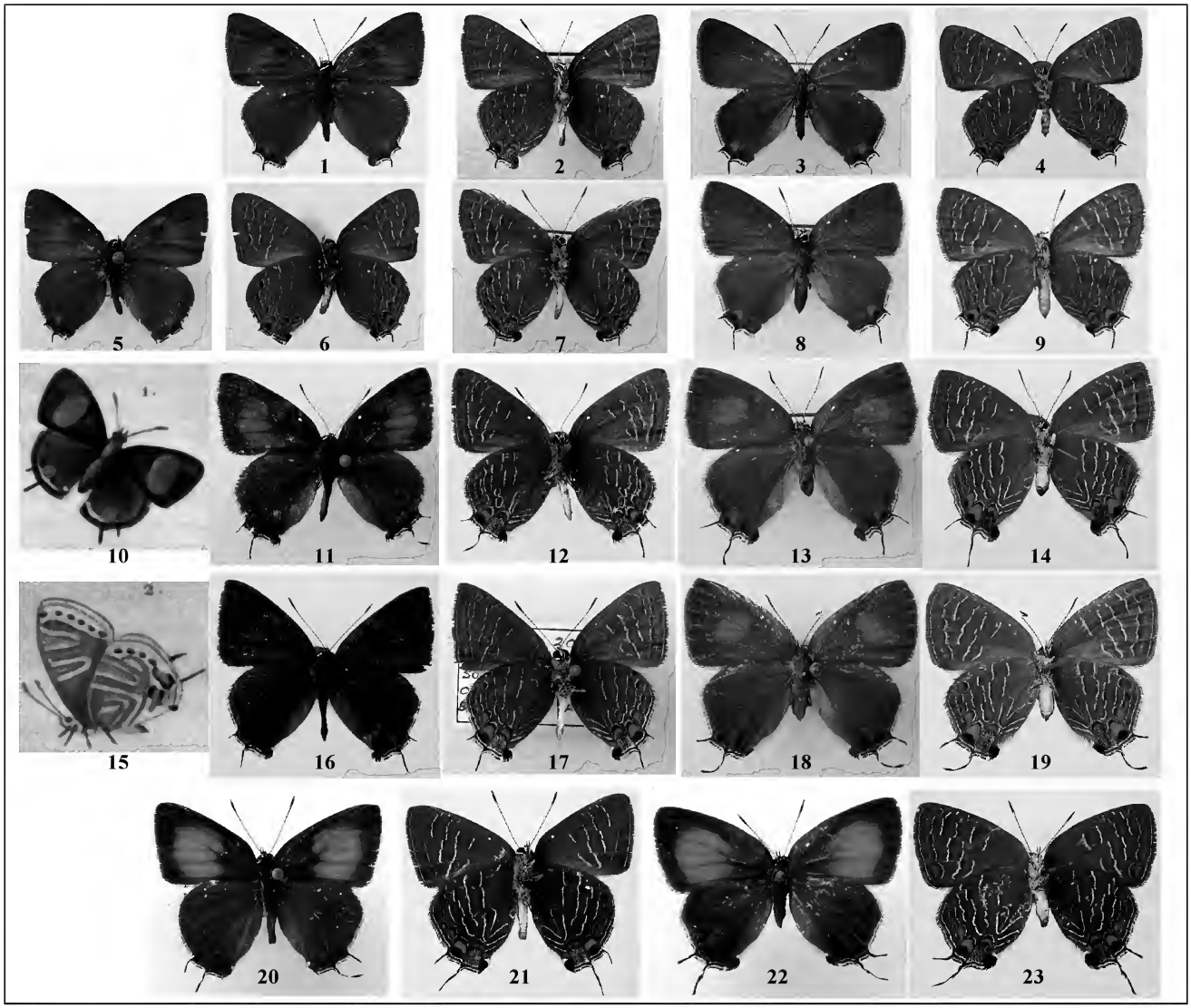
## IDENTIFYING NOMINATE *SATYRIUM LIPAROPS*

The name *Thecla liparops* was introduced into the scientific literature by Le Conte in 1833. This name was based on a painting by John Abbot (Figs. 10/15) which in turn was based on that population of this taxon that is resident to the region of upper Screven County, Georgia. Abbot's paintings are exquisite and life like. Unfortunately, the figures in the original description are not Abbot's originals but poor copies. In the publication process of that time copyists were employed who were obviously greatly inferior in their artistic ability to that of John Abbot. These copies are almost cartoon like and while usually recognizable, are inaccurate representations of the taxon being presented. But even the finest paintings and photographs of butterflies relay nothing to us of the natural degree of variation that occurs in a given wild population.

Scientific names are not really names. They are technical labels which are affixed to organisms to distinguish and organize them according to their present relationships with near relatives as attained by their past evolutionary path. Each unique identifying label (name) is affixed to a specific population and can not

[1] Research Associate, Florida State Collection of Arthropods, Gainesville, Florida.

be moved by subsequent workers to apply to another population of a different evolutionary station – be it another species or subspecies. The linguistic identity of an organism is understood by these Latinized scientific labels. The biological identity of these same organisms is understood by the designation of a type specimen. In the case of Le Conte's *liparops* there is no type. It is the custom of some to consider an original illustration (painting) as the type. (This is a scientific absurdity in my view. The fact that this has been allowed by the ICZN (International Code of Zoological Nomenclature) is one of the primary factors that has made it difficult for today's taxonomists to deal with sibling and cryptic species.)




**Figures 1-23.** *Satyrium liparops* subspecies. **Figs. 1-4.** *aliparops*. **Figs. 5-9.** *strigosum.* **Figs. 11-14, 16-19.** *liparops*. **Figs. 20-23.** *floridensis*. **Figs. 10/5.** Copies of Abbot paintings from Le Conte's original 1833 description. **Figs. 1-2.** D/V ♂ *aliparops:* Colorado, Jefferson Co., Chimney Gulch, 4 July 1981 (leg. M. Fisher). **Figs. 3-4.** D/V ♀ *aliparops*: Colorado, Douglas Co., Baldwin Gulch, 12 July 1975 (leg. M. Fisher). **Figs. 5-6.** D/V ♂ *strigosum*: Massachusetts, Sherborn, 2 July 1973 (leg. Willis). **Fig. 7.** V ♂ *strigosum:* Michigan, Cass Co., Wakelee, 1 July 1973 (leg. unknown). **Figs. 8-9.** D/V ♀ *strigosum*: Massachusetts, Sherborn, 5 July 1973 (leg. Willis). **Figs. 11-12.** D/V NEOTYPE ♂ *S. l. liparops:* Georgia, Screven Co., Millhaven Plantation nr. Brier Ck., 9 June 1994 (leg. Gatrelle). **Figs. 13-14.** D/V ♀ *liparops:* Florida, Liberty Co., nr. Torreya St. Pk., 10 May 1975 (leg. Gatrelle). **Figs. 16-17.** D/V ♂ *liparops:* South Carolina, Orangeburg Co., nr. Bull Swamp, 24 May 2001 (leg. Gatrelle). **Figs. 18-19.** D/V♀ *liparops:* South Carolina, Charleston Co., Hwy 17 at Boone Hall Plantation, 19 May 1974 (leg. Gatrelle). **Figs. 20-21.** D/V HOLOTYPE ♂ *S. l. floridensis*: Data on text page 7. **Figs. 22-23.** D/V Allotype ♀ *S. l. floridensis:* Data on text page 7. ( All photos by Joe Mueller. Specimens X 1.25. D=dorsal, V=ventral.)

In examining the taxon *Satyrium liparops liparops* (Leconte, 1833) we must first determine which geographic population (and thus what evolutionary entity) this label was affixed to. Then we must examine a large enough sample of specimens from that region to understand what the normal morphological parameters are within which this biological entity is defined. The only person to undertake this was the late Harry Clench in 1972. Clench's paper is foundational to this current study. I shall only give some summary and highlights of it here and urge the reader to consult the entire paper.

In his 1972 paper titled: *The Boundary Between* Satyrium liparops *and its Subspecies* strigosum *(Lepidoptera: Lycaenidae)*, Clench gives a thorough account of how this species was originally described. He explains why Boisduval did not want his name associated with this new species and how it became attributed to Le Conte alone. Clench establishes that the type locality should be Screven County, Georgia where Abbot lived and collected his *liparops* specimens. Clench stated the following on page 12.

> The type locality of *liparops* is given in the original description simply as "Georgie." Klots (1951) designated Screven Co., Georgia, without explanation, but presumably because Abbot lived there. There is interesting confirmation of this, however, in the common name that Abbot gave to *liparops* (see above [Abbot called *liparops* the Ogeechee Brown hair streak butterfly]). Ogeechee is the name of the river that forms the southwestern boundary of Screven County; it is also the name of a small creek that courses through the middle of the county; and finally, it is the name of a small town, also in the county. We many never know which of the three Abbot had in mind, but he undoubtedly found his *liparops* somewhere in Screven County.

I will add that Abbot's residence was near Brier Creek (which is actually a small river) just to the north of the town of Sylvania. Ogeechee Creek flows just to the west of Sylvania. It is my opinion that it is this local Ogeechee near his home that Abbot was referring to. The significance here is that this places the type locality not only in Screven County but in its northern half. The southern two thirds of Screven County lies in the lower coastal plain and is dominated by coastal maritime forest and swamps. The northern/northwestern area of the county is in the upper coastal plain (Harris, 1972) and is dominated by the Sandhills Region which is largely xeric in nature. I agree with Klots and Clench that Abbot's *liparops* was found in and reared from a population near his home in upper Screven County, Georgia.

Clench discussed the absence of a type specimen and would have designated a neotype but did not because he felt none of the specimens he had found were geographically close enough to where Abbot first found *liparops* to be a proper biological representative of this taxon. The closest geographic specimen he had found in 1972 was from 10 miles north of Savannah, Georgia, in Chatham County. This was about 35 miles from Screven County (and 50 from the type locality as delimited by this paper). This was very perceptive on the part of Clench as he stated the following on page 3.

> The nature of this change [in phenotype] is such that 35 miles is by no means close enough for the [Chatham Co.] specimen to be reliably representative.

This sentence clearly relays Clench's technical view that a neotype must not come from the coast of eastern Georgia and that is must come from far enough inland to be a true representative of the original Screven County population. It goes without saying that it would be totally improper, in Clench's learned opinion, to designate a neotype from southern Georgia or farther to the south in Florida. If Clench would have thought that proper he would have done so as he had several specimens from those areas. His Chatham county specimen was also in "poor" condition and possessed a small to medium sized red spot on the dorsal forewing - a character which Clench considered transitional to subspecies *S. l. strigosum* (Harris, 1862). It is apparent to me that Clench suspected that the population which is true *liparops* in Screven County would turn out to not be a large patched population. He was correct – it is not.

I have collected one specimen of *liparops* in Screven County. The specimen (Figs. 11-12) is a male and was collected 9 June 1994 along the west side of Brier Creek on Millhaven Plantation in the northern portion of the county. I am aware of no other specimen from Screven County. I here designate this unique specimen as neotype of *Thecla liparops* Le Conte, 1833. This is both necessary and appropriate to provide

a biological entity and biogeographical population on which the name *liparops liparops* is based. I have placed a red label on this specimen that reads (all hand written): NEOTYPE, *Thecla li*parops, Le Conte 1833, designated by R. Gatrelle in TTR 3:3, June 2001. There is a white data label on the specimen with the hand written information of its origin as follows: 9 June 1994, Screven Co., GA, Millhaven Plantation nr. Brier Ck. A third small white label states: Ronald R. Gatrelle collector. This action further defines and restricts the type locality of *Satyrium liparops* to the northern third of Screven County.

In his paper, Clench focused solely on the size of the fulvous patch in defining subspecies *liparops* and *strigosum*. As we shall see this was an error. One of the more significant statements Clench made in his paper is his acknowledgement that other morphological features (which he totally omitted from his analysis) are less variable then the fulvous spot. He states on page13.

> For present purposes I have adopted the development of the fulvous forewing patch as the primary trait separating the two subspecies, but it should be borne in mind that other relevant characters also exist, and some, at least, do not vary in the same geographic pattern.

These unidentified characters are: tail length, ventral ground color, degree of contrast between the white in the stripes and the ground color, and the pattern and amount of red along the margin of the ventral hind wings. In distinguishing *liparops liparops* and *liparops strigosum* these characters are more consistently different between the two subspecies and thus more indicative of their evolutionary subspecific relationship. Had Clench fully incorporated these characters into his analysis he would not only have come away with a much different diagram of the ranges of *liparops* and *strigosum* but an entirely different definition of these taxa. He would have determined that the fulvous patch, while a very pretty and noticeable character, was nonetheless merely a variable character in both *liparops liparops* and *liparops strigosum* that occurred most often in the extreme southeastern part of the range of *liparops liparops.* In other words, the size and frequency of the red fulvous patch in *liparops* and *strigosum* is only a minor secondary character with the above mentioned set of characters being the primary differentiating subspecific elements.

The fulvous patch is present in all subspecies of *liparops*. It is smallest and least frequent (unusual or rare) in subspecies *S. l. strigosum* and *S. l. aliparops* ( Michener and dos Passos, 1942). It is occasional to frequent in subspecies *liparops*. It is largest and most frequent (usual) in the Canadian subspecies *S. l. fletcheri* (Michener and dos Passos, 1942) and (always present) in the new subspecies described herein from west central Florida. In this new Floridian taxon this area is a yellowish burnt-orange while in all the other subspecies it is a red, or rust, orange (when present).

Clench gives a thorough and accurate historic biogeographical assessment of *liparops* in the Southeast and correctly determines that two subspecies are present and that they, as evidenced by a narrow step cline, are the product of two distinct subspecific evolutionary paths that have now come into hybrid contact. He and I are in agreement on this. We differ on two points. One I have already dealt with, which is that *Satyrium liparops liparops* is most properly defined by the set of characters mentioned above and not by its variable fulvous patch – which is, unfortunately, the only character he took into consideration. The other is that the discovery of a massive population further to the south in Florida adds a previously missing and significant piece to this species subspecific evolutionary puzzle that dramatically changes the area and context of his step cline.

In 1973, the year after Clench published this paper, Dr. Larry N. Brown (1976) discovered a population of *liparops* well to the south of the then known range of this taxon in Citrus County, Florida. This population is now known to be a large and robust one that also encompasses the Withlacoochee State Forest in Hernando County. Over the years various collectors have often found *liparops* in this region in large numbers. However, there has never been a taxonomic assessment of this population against nominate *liparops*. I have done this and determined that this population in west central Florida is quite distinct phenotypically and evolutionally and warrants recognition as a subspecific entity.

In reference to Clench's paper, this population represents his hypothesized relict from the Florida refugium rather than those he understood as such in northeast Florida and southeast Georgia. This discovery of the true Wisconsin glacial relict in conjunction with a proper phenotypic definition of nominate *liparops* and a comparison of this relict's unique phenotype against true nominate *liparops* from Screven County, Georgia, necessitates that the step cline is actually further to the southeast of where Clench estimated it was. The tension zone area and population is in fact that which Clench called nominate *liparops*. This is not a radical position as Clench made it very clear in his paper that his findings were very subjective due to the limited number of specimens in his sample and resultant imprecise information he had to work with. The tenuous geographic placement of his step cline in his own mind is evidenced by the following from his page 16.

> *Satyrium liparops* is altogether too rare to expect anything that approaches this ideal in the near future. Mr. Neel's samples, however, are remarkably large for such a scarce species, and they are well disposed. Accordingly I have attempted such a map, even though it has to be approximate rather than precise and definitive.

There is one other very important factor in all this that is not detectable through museum specimens or laboratory analysis. Collectors often pick over specimens they find in the field and only take those which possess some special feature that they are looking for. When these specimens are viewed as a museum series they thus give the wrong impression as to what the actual variation in size and appearance is of the wild population from which they were taken. When collectors "go after" southeastern *liparops* they are usually "looking" for those specimens with the showy orange patch on the forewings. They may either not curate or not even catch those specimens which lack this character.

I have not only viewed curated specimens of *liparops* from various areas of Florida (and collected it in the panhandle), I have spoken with those who have witnessed the natural variation of this entity in the field. Those who have collected the Citrus/Hernando region *liparops* have told me that all the specimens they have seen have the orange patch in both sexes and that it is usually very large. (This is several hundred total specimens witnessed over 20 years.) The field observations of Jeff Slotten are uniquely pertinent to our understanding of where the step cline zone between *liparops* and the new Floridian subspecies lies.

Slotten is a well known lepidopterist and long time resident of Gainesville, Alachua County, Florida. Alachua County lies in the middle of what Clench speculated would be the range of nominate *liparops* as he misunderstood it. Slotten has a great deal of field experience with *liparops* in Alachua, Citrus and Hernando counties. Jeff states that in the Citrus and Hernando County area he has only seen individuals with prominent orange patches on the dorsal forewings. However, in Alachua County he has seen many specimens with very restricted or no orange on the dorsal forewings. He has also told me that the Citrus- Hernando population has a brighter patch than those in his home county of Alachua. Thus, the blend zone between the west central Florida subspecies and true nominate *liparops* begins somewhere to the south of Gainesville, and in conjunction with Clench's analysis, continues to the northeast into southeast Georgia.

In light of what we now know of the range and variation of *liparops* in Florida, we see that what Clench defined was not the southern most evolutionary subspecific unit of *liparops* but the tension zone between true nominate *liparops* of the southern US mainland and the then unknown subspecies that inhabits west central peninsular Florida.

There are three primary evolutionary units within the species *liparops*. Two of these units have each evolved into two subspecies while the third has one. The new subspecies described herein from Florida comprises one unit and is evolved from the Florida refugium as hypothesized by Clench. *Liparops liparops* and *liparops strigosum* form another unit with *strigosum* having arisen from *liparops* with *liparops* being a very old taxon of the Sandhill refugium from Georgia to Mississippi. The third unit is comprised of *liparops aliparops* and *liparops fletcheri* (Michener and Dos Passos, 1942) with *fletcheri* having arisen out of *aliparops* with *aliparops* arising from a western or southwestern refugium. *Fletcheri* and *strigosum,* as residents of glaciated North America, are the most recently evolved taxa.

## DIFFERENTIATING *LIPAROPS* AND *STRIGOSUM*

When producing his 1972 paper, no South Carolina or Mississippi specimens where known to Clench. While in press, he received a letter from myself and a drawing of a female *liparops* I had collected here in Charleston, South Carolina. He included a footnote on this at the bottom of his page 16. On his page 22 he also mentions that after the manuscript had been completed he received a series of nine *liparops* collected along the coast of Mississippi by Kergosien. My specimen had a medium sized fulvous patch; five of the nine Mississippi specimens had no patch. However, four of the Mississippi specimens did have small red patches. Most importantly however, Clench remarked that all specimens had long tails and more extensive orange lunules on the underside of their hindwings than northern populations. These are two of the main characters that differentiate southern *liparops* from northern *strigosum*.

Since the early seventies, I have collected and observed scores of nominate *liparops* in Charleston, Berkeley, Jasper, Aiken and Orangeburg counties South Carolina. All of these populations are nominate *liparops*. I have also personally collected nominate *liparops* in Liberty County, Florida (Figs. 13-14). Red patched individuals occur in all these populations with great regularity. This patch, when present, is usually small to medium sized but some individuals have large prominent red fulvous patches.

Nominate *liparops* ranges from the coast of South Carolina across the southern states and probably into eastern Texas. Specimens I have collected, or observed in other collections, from the mountains of western North Carolina and extreme northern Georgia are near subspecies *strigosum*. In these specimens the tails are markedly shorter and the red of the ventral hindwing margins reduced – however the white lines on the ventral are still fairly prominent and the ground color variable. It is my opinion that these populations are part of the blend zone between these two subspecies.

*Strigosum* was described from Massachusetts. This is fortunate as the populations of *strigosum* there are very distinct from southern *liparops*. The blend zone between *strigosum* and *liparops* is expected to be wide. It is inevitable that various workers will define the characters and region of integration between *liparops* and *strigosum* differently. Thus, it is pointless for me to do so here. I will simply say that my view is that this blend zone is likely wide and covers much of southern Virginia and northern North Carolina. Photos of *liparops* I have seen from southeastern North Carolina indicate that these may well be good *liparops liparops*.

True *strigosum* from the New England states is very different from *liparops* of the deep south. The tails on *liparops liparops* are doubled and quite long even on males (Figs. 11-14,16-19). In *strigosum* males have very small tails and often only one on each hindwing, and while females have two tails they are still very short compared to the two southern subspecies (Figs. 5-9). Table I gives the minimum and maximum measurements of tails on specimens I have seen from the region of their respective original descriptions. The *strigosum* measurements are from 10 specimens from Sherborn, Massachusetts; those for *liparops* are from a series of 65 specimens from Charleston, Aiken and Orangeburg counties South Carolina and the one male from Screven County, Georgia; those for *floridensis* are from the 28 specimens that compose the type series from Hernando County, Florida.

TABLE I. LENGTH OF TAILS IN MILLIMETERS (at veins CU 1 and CU 2)

| SUBSPECIES | male minimum | male maximum | female minimum | female maximum |
|---|---|---|---|---|
| *floridensis* | CU1 – 2.50 CU2 – 4.75 | CU1 – 3.50 CU2 – 5.75 | CU1 – 3.00 CU2 – 5.50 | CU1 – 3.75 CU2 – 6.75 |
| *liparops* | CU1 – 1.50 CU2 – 3.50 | CU1 – 2.50 CU2 – 5.20 | CU1 – 2.50 CU2 – 4.50 | CU1 – 3.25 CU2 – 5.75 |
| *strigosum* | CU1 – 0.20 CU2 – 1.75 | CU1 – 0.75 CU2 – 2.75 | CU1 – 0.75 CU2 – 2.75 | CU1 – 1.50 CU2 – 3.25 |

In addition to tail length, three ventral features differentiate subspecies *liparops* and *strigosum*. In *liparops* the white lines that highlight the bands are much bolder, the red spots along the outer margin of the ventral hindwings are consistently larger, and the ventral ground color in *liparops* is a dark purplish brown in fresh males and deep brown in females while in *strigosum* the ground is a lighter warmer brown.

## *Satyrium liparops floridensis*

The relict subspecies of *liparops* in west central Florida is unique in the yellowish burnt-orange color of its dorsal fulvous patch. Specimens in the tension zone of the step cline to *liparops liparops* occasionally have this color, or very close to it, on their forewings also. However, in the tension zone many individuals are also found with little or no fulvous and others in which the fulvous is a dusky red-orange as in the more northern races (see Slotten's comments on page 5). This is the only subspecies of *liparops* that always has fulvous on the forewings. In Clench's 1972 paper the maximum size of the fulvous area in specimens he had before him was 6 X 7 millimeters. Several specimens in the type series have this patch up to 8 X 9 millimeters. These specimens are the same overall size as nominate *liparops* from Charleston, South Carolina. Likewise, as seen in Table I, the tails on this new subspecies are extremely long also even though the adult size is basically the same as in subspecies *liparops*.

In this new subspecies the red markings on the ventral hindwings are not greatly different from those of nominate *liparops* - being only somewhat more expansive. While I consider the amount of red on the ventral surface to be a subspecific character between *liparops* and *strigosum,* I considerer this feature of minimal import in assessing the two southern subspecies.

The major feature of the ventral surface is the dramatic contrast between the dark chocolate brown ground color and the vivid white striping of the banding in both sexes. In subspecies *aliparops*, *fletcheri* and *strigosum* this white banding is occasionally almost obsolete in many specimens, especially in *aliparops*. These differences are readily observed from the specimens figured on page two and further verbal description would add nothing more to them.

There can be no question about the subspecific distinctness of this Floridian segregate. Further, the location and population to which the name *liparops* is affixed, by the rules of science, renders that name totally unavailable for this unique and beautiful entity. It is my privilege to have been able to work out the taxonomy of this subspecies and give it a scientific identity (name). Many others have much more experience with this in the field than I, beginning with Dr. Larry N. Brown on 15 May 1973. I had thought about naming it after one of the fine field lepidopterists familiar with it. But that would be unfair to the ones not so acknowledged. I therefore simply affix an identity to it in reference to the state of Florida from which it arose evolutionally and to which it is presently confined.

### *Satyrium liparops floridensis* Gatrelle, new subspecies

**Description.** ***Male*** (Figs. 20-21). *Head, thorax, abdomen* and appendages as in nominate *liparops*. *Forewings*: dorsally, uniform dark brown ground with large median yellowish burnt-orange patch occupying over half the surface of the wing; an elongate stigma is situate along the coastal margin; ventrally, ground color deep chocolate brown (purplish in fresh specimens), white dash lines prominent and far apart with the areas between the lines the same color as ground or only slightly darker and otherwise unmarked. *Hindwings*: dorsally, ground same as on forewing and unmarked except rarely with a slight amount of red orange scaling along the outer margin in cell Cu1; tails black with white tips very long and double with one shorter at vein Cu1 and one longer at Cu2 with the longest usually over 5 millimeters long; along the entire outer margin is a series of red spots with those is cells Cu1 and Cu2 capping black and blue marginal spots respectively, there is also a thing white line all along the margin just inside the brown fringe; there is a large black dot at the anal angle capped with white and then red orange. ***Female*** (Figs. 22-23). In all aspects as in the male with the following exceptions. *Forewings*: dorsal, lacks stigma; the fulvous patch tends to be more reddish but is likewise large; ventral, often with a series of small diffuse red spots along the outer margin; ground color sometimes slightly lighter than in male. *Hindwings*: dorsally, the red orange scaling along the outer margin is more frequent and larger to actually form a spot; longest tail often 6 millimeters long; ventrally, the marginal red markings more pronounced than in male.

**Types.** ALL: FLORIDA. *Holotype* ♂ (Figs. 20-21): Citrus Co., Withlacoochee St. Forest, Rd. 11, 2 May 1985 (leg. Baggett). *Allotype* ♀ (Figs. 22-23): Hernando Co., Withlacoochee St. Forest, 29 April 1979 (leg. Slotten). *Paratypes*: 8♂♂, 18♀♀: Hernando Co., Withlacoochee St. Forest: 1♂, 6♀♀, 29 April 1979 (leg. Slotten); 5♂♂, 3♀♀, 20 April 1980 (leg. Baggett); 2♀♀, 25 April 1981 (leg. Baggett); 1♂, 2♀♀, 1 May 1983 (leg. Godefroi); 1♀, 28 March, 1♀, 29 March, 1♀, 22 April 2000 (leg. Slotten). Citrus Co., Withlacoochee St. Forest: 2♀♀, 2 May, 1♂, 27 April 1985 (leg. Baggett). The Holotype

and allotype are currently deposited in the Museum of the Hemispheres (MOTH), Goose Creek, South Carolina. The 26 paratypes are deposited as follows: MOTH, Goose Creek, SC. (5), FSCA, Gainesville, Florida (16), personal collection of Jeff Slotten (5).

**Type locality.** Withlacoochee State Forest, Citrus County, Florida.

**Etymology.** Named after the state of Florida. I recommend Sparkleberry Hairstreak as its common name as this shrub is both a primary larval host and usual adult nectar source at the type locality.

**Remarks.** It would not be unexpected to eventually find that *floridensis* ranges across mid Florida to the Atlantic coast. The historic record from Flagler County, Florida, while farther to the north and on the east coast may be of this subspecies. I say this as it is very typical for taxa to range farther north on the east coast of Florida than on its west coast. However, the geologic history of Florida is such that at one time the west coast area extended vastly to the west into what is now the Gulf of Mexico. There is indication that some taxa on the east and west coasts of Florida evolved from different routes. Sparkleberry (*Vaccinium arboreum* Marshall) is the primary host of *S. liparops floridensis* in the Withlacoochee State Forest area. This butterfly is local but may be fairly common where found.

---

## ACKNOWLEDGMENTS

I thank Jeff Slotten for his special contributions toward the success of this research through his field experience with this species throughout Florida. I also thank the late Harry Clench with whom I often corresponded and who shared much information with me on Southeastern Hairstreaks. I also thank the late J. F. Gates Clarke of the Smithsonian (USNM) for supplying a color photograph of the original Abbot figure. Dr. Clarke was also a big help to me when I began investigating the Butterflies and Skippers of this region 25 years ago.

## LITERATURE CITED

CLENCH, H. K. 1972. The Boundary Between *Satyrium liparops* and its Subspecies *strigosum* (Lepidoptera: Lycaenidae). Annals of the Carnegie Museum, Pittsburgh. Vol. 44, pp. 11-24.

BROWN, L. N. 1976. A Population of the Striped Hairstreak, *Satyrium liparops liparops* (Lycaenidae), in West-Central Florida. Journal of the Lepid. Soc. Vol. 30:3, page 213.

HARRIS, L., Jr. 1972. Butterflies of Georgia. Univ. of Okla. press, Norman OK. 326 pp.

---


# The Taxonomic Report

is a publication of ***The International Lepidoptera Survey (TILS).***

(A Tax Exempt Non-Profit Scientific Organization )

***The Taxonomic Report*** is projected for publication at the rate of 8-10 issues a year. Subscription/ dues for Volume Three are $45 US for domestic and $55 US for overseas subscribers. The subscription year follows the calendar year. All issues are mailed 1st class. At the end of each year, subscribers receive that year's volume on a record-only compact disc (CDR) for permanent archiving and reproduction for personal use (i.e. a museum or university may make as many copies as needed in whatever format desired). Non-members may receive individual issues in print any time for $10 per issue. Individual issues on CDR to non-members are $25 per issue post paid. **Subscriptions** and **individual issue** orders should be made payable to **TILS;** and **mailed to:** Treasurer, 126 Wells Road, Goose Creek, SC USA 29445-3413.

Volume 3 12 August 2001 Number 4

The Taxonomic Report

OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# AN EXAMINATION OF THE *MITOURA* (LYCAENIDAE) IN THE SOUTHEASTERN UNITED STATES: WITH THE DESCRIPTION OF A NEW SUBSPECIES OF *MITOURA HESSELI.*

RONALD R. GATRELLE
126 Wells Road, Goose Creek, South Carolina 29445

**ABSTRACT.** Four subspecies of *Mitoura grynea* occur in the United States east of the Mississippi River. The nominate subspecies occupies this entire area except for Florida and the coastal regions of South Carolina and Georgia. *M. g. grynea* is usually associated with *Juniperus virginiana.* A neotype is designated for *Lycus gryneus* from Aiken County, South Carolina. *M. grynea smilacis* is endemic to the southeastern coastal islands and coastal mainland from about Brunswick Georgia north to the Santee River delta of South Carolina. *Smilacis'* range corresponds to that of *Juniperus silicicola* in that area. A neotype is designated for *M. grynea smilacis* from Chatham County, Georgia. *M. grynea sweadneri* is endemic to eastern Florida (especially along the coast) from about Jacksonville southward. *M. g. sweadneri* rarely has any fulvous scaling above. *Sweadneri's* range corresponds to that of *Juniperus silicicola* in that area. A fourth subspecies is discussed but not described. This entity inhabits west central Florida. This subspecies tends to have yellowish red fulvous above and yellowish green ground below. *Mitoura hesseli* is represented in the eastern and southern United States by two subspecies. *Mitoura hesseli hesseli* ranges from Maine south through Virginia to northern North Carolina. *Mitoura hesseli angulata* Gatrelle is described from Aiken County, South Carolina. It is larger, ventrally darker, has a more angulate ventral median band and longer tails than nominate *hesseli. M. h. angulata* ranges from the southern sandhills of South Carolina southward into northern Florida. The populations in southeastern North Carolina are intermediate. The neotypes of *grynea* and *smilacis* and the holotype of *angulata* are currently deposited in the Museum of the Hemispheres, Goose Creek, South Carolina.

**Additional key words.** Genitalia, host associations, isolation.

## *MITOURA GRYNEA*

### *MITOURA GRYNEA GRYNEA*

With *Mitoura grynea* (Hübner, 1819) we again come to a taxon which was likely discovered by John Abbot in eastern Georgia. This is somewhat problematic as *Mitoura grynea smilacis* (Boisduval and Le Conte, 1833) is also an Abbot species from this same region (Forbes, 1960). There are no type specimens for either of these taxa. In order to insure the continued prevailing usage of these names, neotypes are designated herein for both of these taxa.

The first name applied to this hairstreak was *Papilio damon* Stoll, 1782 (Figs. 19-20). This name, however, was preoccupied by a European Blue of the same name. Both Hübner's *Lycus gryneus* and *Polyommatus damastus* Godart, 1824 were new names proposed for the preoccupied *damon* (Forbes, 1960). The type specimen of *damastus* is extant in the National Museum of Natural History, Paris. This specimen however, is a *Calycopis cecrops* (Fabricius, 1793) and not a *grynea* (see Johnson, 1991).

The original description of *Papilio damon* by Stoll is typical of the very brief descriptions of that day. It is given in both Dutch and French. Here is the Dutch version followed by the English translation.

*Fig. C. D. Damon.* Behoort onder het Gezin der Schildrups – Pagies (*Pap. Pleb. Rural.*) en heft de groene kleur op de onderzyde der vleugelen satynagtig glanzig. Men vindtze in *Virginien.*

*Figs. C and D Damon.* … of the shield larvae - Belongs to the family Pap. Pleb. Rural and has a green color on the underside of the wings that shines like satin. It occurs in Virginia.

As can be seen from the reproduction of the original figures, Stoll's insect is what we are familiar with today as *Mitoura grynea*. Stoll's figures were based on specimens from Virginia.

*Lycus gryneus* Hübner, was introduce in 1819 without description by the following simple caption which simply references Hübner's name *gryneus* to Stoll's description and figures. I have not been able to locate a Hübner figure of this and am not sure if there is one or not. This however, is of little consequence and I have thus not pursued that aspect at length.

732. L. Gryneus. Damon Cram. 390. C. D.

To this point in time, all of the southern U.S. Hübner names I have investigated over the years have been based on material collected by John Abbot in Georgia. Abbot collected many species near his home in what is today's Burke and Screven counties, Georgia. He also collected at least a few of his new species only in the coastal area of Georgia. We know this because the species he painted either do not occur in Burke or Screven counties at all, or if they do, not in the subspecies he depicted. The most certain exclusively coastal Abbot taxa are: *Problema bulenta* (Boisduval and Le Conte, 1834), *Euphyes arpa* (Boisduval and Le Conte, 1834), *Anthocharis midea midea* (Hübner, 1809), *Satyrium calanus calanus* (Hübner, 1809), *Fixsenia favonius favonius* (J.E. Smith, 1797), *Hemiargus ceraunus antibubastus* (Hübner, 1818) and *Mitoura grynea smilacis* (Boisduval and Le Conte, 1833).

The lepidopteran fauna changes greatly over the 60 miles from the Georgia coast to Screven and Burke counties. This is a result of the differing geologic and ecological development of these areas. Several species occur as one subspecies along the coast and another inland with less than 40 miles between them. One such subspecies pair is *Mitoura grynea grynea* and *Mitoura grynea smilacis*.

The *grynea* in Burke County are part of the subspecific entity that has long been referred to as nominate *grynea* over most of eastern North America. I have not yet found *grynea* in Screven County though it is likely there. The *grynea* that occurs along the immediate coast of Georgia and its coastal islands is subspecies *smilacis*. The Abbot painting of *smilacis* in its original description is clearly the coastal segregate. Thus, this name is not a problem (we shall deal with this later). Stoll's *grynea,* depicted under the name *damon,* is clearly the northern/inland subspecies.

The problem is that it is possible that Hübner's name *grynea* may have actually been based on Georgia's coastal population too. This is a real possibility as species *grynea* is much more common along the coast than inland. If this were to be the case, and because coastal *smilacis* is a very good subspecies, this would mean that, 1) *smilacis* would be a junior synonym of *grynea,* 2) the name *grynea* would then be restricted to the subspecies along the coast of Georgia and South Carolina, and 3) would require that the *grynea* populations in the rest of eastern and Midwestern North America be given another epithet. This would cause serious instability in the longstanding usage, and understanding, of the name *grynea*.

Regardless of whether or not there is a Hübner depiction of *grynea*, and regardless of what it may look like if there is one, the proper course of action is to focus on Hübner's equating of his name *grynea* with Stoll's name *damon* and therefore maintain Hübner's application of the name *grynea* to the inland/northern traditional subspecies. This situation requires the designation of neotypes for both *grynea* and *smilacis* to maintain nomenclatorial stability. I herein do this which maintains stability without sacrificing the integrity of the two biological subspecies concerned.

The primary consideration was where to affix the type locality. I have various specimens from Virginia which would accommodate the Stoll location (Figs. 22-24). However, the name was Hübner's and based on Abbot material. It was thus appropriate to align the type locality with the work of Hübner and Abbot and use a southern location. I have observed just a few *grynea* in Burke County (I have not been at

the right place at the right time) and collected only one. Unfortunately, it is in poor condition and not suitable for a neotype. It is definitely the nominate *grynea* phenotype however. A small series of *grynea* which I have collected in neighboring Aiken County, South Carolina are of the same biogeographic population as those in adjoining Burke County. I have therefore chosen to designate a specimen from Aiken County, South Carolina as the neotype. The neotype of *Lycus gryneus* Hübner, 1819 is a male (Figs. 29-30) with the following labels and data. A red label with the hand printed words: NEOTYPE. *Lycus gryneus* Hübner, 1819 designated by R. Gatrelle in TTR 3:4 August 2001. A white label with the hand printed words: March 29, 1988, Aiken State Park, Aiken County, SC. A small white label machine printed with: collector, Ronald R. Gatrelle; and hand printed: ♂ *M. grynea*. This specimen is currently deposited in the International Lepidoptera Survey's Museum of the Hemispheres, Goose Creek, South Carolina.

This same action was taken by H. A. Freeman (1952) in designating a neotype for *Megathymus yuccae* (Boisduval and Le Conte, 1834) from Aiken County. This name was based originally on Burke/ Screven County specimens collected by Abbot. Therefore this action is not without precedent.

## INTERMEDIATE POPULATIONS

I have discussed the geological formation of the Sandhill region and coastal area of Georgia and South Carolina in other papers on the taxa in this area (Gatrelle, 1998, 1999, 2001). Before the arrival of Europeans in this area, much of the butterfly fauna of the Sandhill region was isolated from the fauna of the coastal marshes and pine-hardwood islands along the coastal plain of Georgia and South Carolina by a dense jungle of swamp forests that lay between these two areas. Over the last 400 years this barrier has effectively been removed by the activities of man. This alteration has allowed several sister subspecies to extend their ranges toward each other in this area. This will eventually culminate in the contact of these taxa and ultimately the genetic mixing of both. This in turn will result in the eventual extinction (by absorption) of the coastal subspecies and the likely morphological altering of the inland ones.

*M. grynea grynea* (inland) and *M. grynea smilacis* (coastal) are subspecies of differing evolutional lineages which are extending their ranges closer to each other due to the above ecological alteration. Any area where they meet is thus a tension zone rather than a blend zone. The tension zone between *grynea* and *smilacis* is very narrow. The populations I have experience with that pertain to this geographic change from *smilacis* to *grynea* are in Bryan County, Georgia and Barnwell, Berkeley and Dorchester counties South Carolina. This change in subspecies correlates with the range of their host trees in this same area: *Juniperus silicicola* for *smilacis* and *Juniperus virginiana* for *grynea* (Radford et. al. 1968).

Bryan County, Georgia is a narrow and long county that runs from the Georgia coast inland to Bulloch County. On its eastern side it borders Chatham and Effingham counties. There is a sizable colony of *M. grynea smilacis* in the northeast corner of Fort Stewart Army base just inside Bryan County near the junction of Bryan, Effingham and Chatham counties. Both *J. virginiana* and *J. silicicola* were present in this area when I collected there in 1977. Dr. R. T. Arbogast directed me to this site. Dr. Arbogast was a long time resident of Savannah and collected in that area of Bryan County often. This colony is the furthest known inland colony of *smilacis* in northeast coastal Georgia. This area is only 60 miles south of where I observed nominate *grynea* in Burke County. This indicates that intermediate populations may well occur in Screven County which is only 30 miles from this colony.

Dorchester County, South Carolina is to the northwest of Charleston County. Givhans Ferry State Park straddles Dorchester and Colleton counties and is 30 miles inland. In 1976 I located a small *smilacis* colony in the Dorchester portion of the park about three *Juniperus* trees on a bluff overlooking the Edisto River. The trees were quite old and I was not sure if they were *virginiana* or *silicicola*. My opinion is that they were *virginiana*. I say were, as they were victims of Hurricane Hugo in 1989. The bulk of the specimens from this colony were typical *smilacis* but some specimens I examined exhibited phenotypic

characters that leaned toward *grynea*. I consider this colony still taxonomically referable to as *smilacis* (Fig. 39). The importance of the presence of specimens with some intermediate characters here (Fig. 40) serves to demonstrate that true *smilacis* does not extend inland far from the coast.

*Smilacis* extends up the Cooper River into Berkeley County to Moncks Corner. There was once a very large *J. silicicola* forest on the west bank of the Cooper River just south of Moncks Corner. This site is now largely gone as it was destroyed in the construction of an upscale waterfront subdivision without regard for the site's unique native flora and fauna. As this colony was not far from my home I was able to study it frequently. It had two full broods with the first peaking in late April (numbering in the thousands by conservative estimates) and the second emerging from July to September. Dorsally red individuals were very frequent. About 10% of the specimens at this site have the ventral median line tending toward subspecies *grynea* (Fig. 42). I reared specimens from this colony twice on a *Chamaecyparis thyoides* L. I have planted in my yard. I do not know how far north *smilacis'* range extends along the coast.[1]

In 1977 and 1988 I collected and/or examined specimens of *grynea* (Figs. 35-36) in and around Barnwell State Park in Barnwell County, South Carolina. The colony in this area is subspecies *grynea*. However, some of the specimens there exhibit ventral characters that lean toward *smilacis* – smaller basal hindwing spots and a straighter median band. Barnwell County is just across the Savannah River from Burke County, Georgia and approximately 75 miles from the coast. The area is 24 miles south of the *grynea* type locality at Aiken State Park in adjoining Aiken County.

As can be seen, I have not located a colony that is intermediate to subspecies *grynea* and *smilacis*. What I have noted is that a small number of *smilacis* specimens in the Berkeley and Dorchester County populations lean to *grynea* and that a few specimens of *grynea* in the Barnwell population lean toward *smilacis*. The Dorchester County colony showed the most variation.

## *MITOURA GRYNEA SMILACIS.*

*Thecla smilacis* Boisduval & Le Conte, 1833. Here translated from the original French into English.

> It has the carriage and size of *Thecla Acaciae* of Europe. The top of the wings is the same brown-blackish, with a small whitish matte [flat finish] near the middle of the superior [upper] part; the lower wings have toward the end [tip] two small pitted tails at the crest white as in similar species.
>
> The lower part of the wings is of a less brilliant green than in the *rubi*, often washed with a little reddish, marked beyond the middle of a transverse white stripe, winding and wavy on the upper wings, winding on the lowers, bordered in front by a rust-colored faded imperceptibility with a green color. Between this stripe and the base of the lower wings have another short transversal stripe, sinuate, of the same color. The borders of these two wings is marked by two or three ashy crescents of which the intermediary is black in front, and the third aligned with two or three small rust-colored spots, more or less distinct. The anal area is black, and near the fringe there is a small white marginal line, almost nothing on the uppers.
>
> The caterpillar is green, with blackish head and feet. It is marked with four rows of red spots, of which the two dorsals are formed with similar spots, and one on each side formed with spots a little larger.
>
> The chrysalis [pupa] is a grayish-brown, with the abdomen more light and reddish.
>
> It is found in Georgia on the *smilax*. It is at present very rare in collections.
>
> This species forms a small group with the *Thecla chlorion* and *simaethis*.

A most interesting aspect of this description is that the larval host is given as *smilax* and that it is named after this plant. The genus *Smilax* is a modest sized assemblage of dioecious, herbaceous or woody vines. While vines of this genus are frequently found growing in Red Cedar trees, *grynea* larvae do not feed

[1] In editing this manuscript, Harry Pavulaan relayed that in 1999 he collected a female *Mitoura* in a stand of *J. silicicola* at the inland edge of a salt marsh near Ocean Isle Beach in Brunswick County, North Carolina. He stated that the individual tended more in overall phenotypic characters toward *smilacis* than nominate *grynea*. He also confined the individual on both male and female branches of *J. virginiana* for a period of 14 days where she refused to oviposit.

upon it. The genus was described by Linnaeus so the name was known to be associated with these vines well before the *smilacis* description in 1833.

The distinguishing subspecific taxonomic markings of *smilacis* are found on the ventral hindwings and the dorsal forewings. The two markings at the base of the ventral hindwings of *smilacis* may be absent (infrequent), dots (frequent) or aligned straight bars (frequent). They are never as in typical eastern *grynea* where this lower marking is usually offset marginally in the shape of a V (Fig. 24). In the description above, these two markings are described by the words: short, stripe and sinuate. In the copy of Abbot's painting they are two dots and in line (Fig. 21). Those *smilacis* specimens that have these markings present as dots or absent are in this respect marked like subspecies *M. grynea sweadneri* F. H. Chermock, 1940.

*Smilacis* also resembles *sweadneri* in that the hindwing median line is straight or only slightly wavy. This is very different than in *grynea* where this line is very crooked (Figs. 30 & 36). This difference between *grynea* and both *smilacis* and *sweadneri* is produced by the alignment of the intercellular median mark between veins M1 and M3. In *grynea* this line tends to lay horizontal along M3 and then bend upward at its mesial end to veins M2 and M1. In both *smilacis* and *sweadneri* the line in this interspace is vertical (Figs. 26 & 28). These differences between *smilacis* and *grynea* and similarities between *smilacis* and *sweadneri* point to *smilacis'* evolutionary closeness to *sweadneri* and distance from *grynea*.

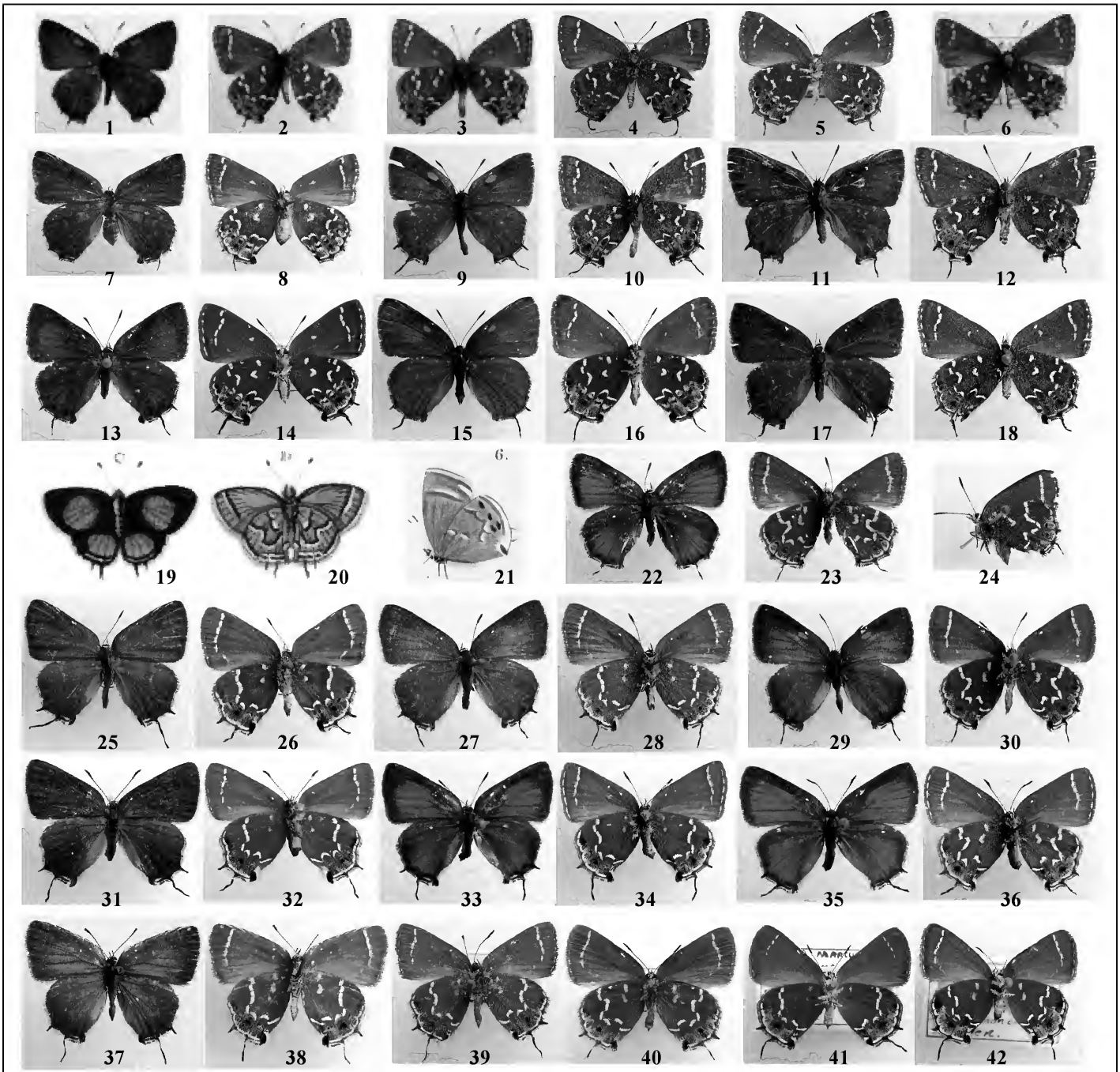
*Smilacis* is virtually unknown in collections. To many workers, it was only known from the original description and figures. It was therefore assumed by most of the older workers that *smilacis* lacked fulvous above. This also led a number of the older taxonomists to simply consider *smilacis* a "form" of *grynea* that lacked fulvous above. In actuality *smilacis* frequently has a good amount of red fulvous scaling on the dorsal forewings, especially in females (Fig. 33). I have collected scores and observed hundreds of *smilacis* along the north coast of Georgia and south coast of South Carolina. Fulvous specimens are more numerous than all dark specimens in the spring brood, and in the summer and fall broods about a third of the specimens are very fulvous above. The name *smilacis* is absolutely not based on a form.

While many *smilacis* look very much like *sweadneri* ventrally, their dorsal forewings are most often marked like subspecies *grynea*. Individuals of subspecies *sweadneri* rarely have any fulvous above and if so it is limited to a very faint patch of a few scales. This phenotypic feature points to *smilacis'* evolutionary distance from *sweadneri* and toward *grynea*. What we have then is a taxon that is morphologically as unique as any of the many other North American subspecies now considered as part of species *grynea*.

*Mitoura grynea smilacis* is endemic to a very narrow and unique semi subtropical coastal life zone that extends from the Santee River delta of South Carolina in the north then south to Jacksonville, Florida. That area is composed of hundreds of barrier islands and salt marsh where *smilacis* and its larval host, *Juniperus silicicola,* are both common. This does not mean that this unique subspecies is without peril. On Edisto Island, Colleton County, South Carolina, there was once a thriving abundant population. It is now scarce there due to beach area housing development. This type of expensive development is a plague to flora and fauna along the entire southeastern seaboard. Further, in this zone, *smilacis* probably does not range south of Brunswick, Georgia as it blends to subspecies *sweadneri* southward.

As discussed under *grynea grynea*, *smilacis* does not range far inland from the coast. While it is clear that for thousands of years *smilacis* and *grynea* were isolated from each other by the forest swamps between the Sandhills and coastal islands, there was no such barrier between *smilacis* and *sweadneri*. Thus, *smilacis* and *grynea* are meeting in a tension zone while *smilacis* and *sweadneri* meet in a blend zone.

I am here designating a male from Chatham County, Georgia as neotype of this neglected and unique subspecies (Figs. 27-28). The neotype of *Thecla smilacis* has the following labels and data attached to it. A red label with the hand printed words: NEOTYPE. *Thecla smilacis* Boisduval & Le Conte, 1833 designated by R. Gatrelle in TTR 3:4 August 2001. A white label with the hand printed words: March 20, 1976, nr. Fort Pulaski, Chatham County, GA. A small white label machine printed with: collector, Ronald R. Gatrelle; and hand printed: ♂ *M. g. smilacis*. This specimen is currently deposited in the International Lepidoptera Survey's Museum of the Hemispheres, Goose Creek, South Carolina.




**Figs. 1- 42.** Eastern *Mitoura*. **1-2:** ♂ *hesseli*, 10 May 1987, Lebanon St. For., Burlington Co., NJ (leg. unknown). **3:** ♂ *hesseli*, 13 May 1984, Blue Hills Res., Norfolk Co., MA (leg. unknown). **4:** ♂ *hesseli,* 20 April 1974, nr. Raeford, Hoke Co., NC. **5:** ♀ *hesseli*. ex pupa 12 June 1976, nr. Raeford, Hoke Co., NC. **6:** ♂ nr. *angulata*, 29 April 1988, St. Rd. 211, Brunswick Co., NC (leg. Zeligs). **7-8:** ♀ *hesseli,* 20 July 1972, Chatsworth, NJ (leg. Douglas). **9-10:** ♂ *angulata*, 1 April 1978, 10 mi. E. Sumatra, Liberty Co., FL (leg. Roman). **11-12:** ♀ *angulata*, 30 March 1979, 8 mi. E. Sumatra, Liberty Co., FL (leg. Baggett). **13:** paratype ♀ *angulata*, 21 April 1984, nr Aiken St. Pk., Aiken Co., SC. **14:** paratype ♀ *angulata*, ex ova 3 May - pupa 15 June 91, same data as 13. **15-16:** HOLOTYPE ♂ *M. h. angulata*, ex ova 4 May - pupa 19 June 1990, same data as 13. **17-18:** allotype ♀ *M. h. angulata*, 20 April 1990, same data as 13. **19-20:** Stoll's *damon* in Cramer 1782. **21:** B & LCt's *smilacis*, 1833. **22-23:** ♀ *grynea*, 6 May 1976, Fairfax Co., VA (leg. Hartgroves). **24:** ♂ grynea, same data as 22. **25-26:** ♂ *sweadneri*, 6 March 1976, New Smyrna Beach, Volusia Co., FL. **27-28:** NEOTYPE ♂ *M. g. smilacis*, 20 March 1976, nr. Ft. Pulaski, Chatham Co., GA. **29-30:** NEOTYPE ♂ *M. grynea*, 29 March 1988, same data as 13. **31-32:** ♀ *sweadneri*, 8 March 1975, St. Augustine, St. Johns Co., FL. **33-34:** ♀ *smilacis*, 19 March 1977, Hwy 204 nr. Ogeechee R., Bryan Co., GA. **35-36:** ♀ *grynea*, 26 March 1977, nr. Barnwell St. Rk., Barnwell Co., SC. **37-38:** ♂ *grynea* undescribed, 5 May 1974, Istachatta, Hernando Co., FL. **39:** ♂ *smilacis*, 13 March 1976, Givhans Ferry St. Pk., Dorchester Co., SC. **40:** ♀ *smilacis* nr. *grynea*, same data as 39. **41:** ♀ *smilacis*, ex ova 30 March - pupa 19 May 1991, on Cooper R. nr. Moncks Corner, Berkeley Co., SC. **42:** ♀ *smilacis*, ex ova 27 March - pupa 25 May 1991, same data as 41. Specimens are 1.15 actual size. All specimens leg. R. Gatrelle unless otherwise noted. Photos by Joe Mueller.

In the early and mid 1970's, while *Mitoura grynea sweadneri* was still rather plentiful along the east coast of Florida from Jacksonville south to Brevard County, I encountered this species several times. The most abundant colony was encountered at New Smyrna Beach, Volusia County. It was also widespread in the St. Augustine area including the type locality. I have not been to any of these sites for many years and thus can not personally speak to its abundance or scarcity now. It is reportedly still fairly common in some areas, but I know of no detailed published accounts in recent years.

This subspecies is fairly well known. Some workers had postulated that this might actually be a full species. This is not the case as it blends to *smilacis* in the north and to the west to a slightly different phenotype (which I shall discuss below), and then to the northwest to nominate *grynea*. Further, it is now known that the genitalia of the *Mitoura* blend from subspecies to subspecies in this group along with their morphology and phenotypes (e.g. Robbins, 1990). The *sweadneri* populations in the vicinity of Jacksonville begin to show blend zone characters toward *smilacis* (increased dorsal fulvous and basal bars on the ventral hindwings). Thus, I do not consider true *sweadneri* to range much further than the Florida – Georgia state line on the Atlantic coast. As stated by Calhoun (1997), it is a Florida endemic.

While the *smilacis* figures presented herein are the first ever photos of that subspecies, s*weadneri* is illustrated in several publications. *Sweadneri* is defined by the following characters (Figs. 31-32). Ventrally, the hindwing's two basal marks are either two dots or absent; the median line is fairly straight as in most *smilacis*, however, the inward part of the white median line often has a wide brown boarder; the black marginal spot in cell CU1 is not very large. Dorsally, the wings are usually a dark brown and rarely have reddish fulvous scaling, which when present, is faint and restricted.

The species *grynea* is recorded from 20 counties across northern and central Florida. Nineteen of these have been attributed to subspecies *sweadneri* (Calhoun, 1997). My taxonomic analysis is that this attribution is only partially correct, as the populations in western Florida differ significantly from typical *sweadneri*. However, the correct taxonomic placement of this west coastal Florida non-*grynea*/non-*sweadneri* entity is uncertain at this time and needs further study.

I have had a fair amount of experience with species *grynea* in Florida over the years. I have encountered *sweadneri* at 5 locations on the east coast, and the non (or near) *sweadneri* populations at 5 other locations in Hernando, Citrus, and Levy counties. In total, this amounts to a few hundred specimens of both entities. I have also viewed numerous Florida specimens in various personal collections and the Florida State Collection of Arthropods, Gainesville.

On the ventral hindwings, the population in west Florida seems allied to both *smilacis* and *sweadneri*. The basal markings are almost always dots (or absent), but I have seen a few specimens where these begin to become bars. The black marginal spot is also usually smaller than in east coast specimens. To my eye, the green ground color tends to a yellowish hue in some individuals, while in *sweadneri* the green is very dark and even brownish in some specimens. The big difference however, is on the dorsal surface where the west Florida population often has very noticeable fulvous areas (Fig. 37). Further, this fulvous tends to be yellowish, and while never real strong, it is reminiscent in shade to that of the western subspecies *M. grynea castalis* (W. H. Edwards, 1871). I had, at one point, decided to describe this entity as a new subspecies herein. However, I have decided this needs more study. This does not mean though, that these should be referred to as *sweadneri*. For now, they should be referred to as either near *sweadneri* or, perhaps more properly, as near *smilacis*.

The main question is, by what evolutional path did this west Florida entity come into being? Is it a descendant from a *grynea* that might have inhabited western Florida at a glacial maxima when the west coast of Florida and areas of the Gulf coast extended many miles into the gulf of Mexico from where it is today? Or, did it move down into its present location from an ancestor to the north? How is it related evolutionally to *sweadneri*? These issues call for further research.

## *MITOURA HESSELI*

*Mitoura hesseli* Rawson and Ziegler, 1950 was described from Lakehurst, Ocean County, New Jersey. There are two subspecies of *hesseli* in the eastern United States. This has been known for some time. Northern (nominate) *hesseli* ranges from southern Maine south to north coastal North Carolina. The populations in south central North Carolina are intermediate between nominate *hesseli* and the southern subspecies described below. The few specimens I have seen from the coastal population in Brunswick County, North Carolina also appear intermediate but lean toward the southern subspecies (Fig. 6).

I first became familiar with *hesseli* and its habitat in Hoke and Cumberland counties, North Carolina beginning in July 1973. I have collected/observed scores of specimens from that area on several occasions. I have also reared the Hoke County population twice (Fig. 5). On 23 April 1977 I discovered an undocumented stand of its larval host, *Chamaecyparis thyoides* L, near Aiken State Park in Aiken County, South Carolina. On 21 May 1977 I subsequently collected a female at this new site for a South Carolina state record. This was also one of the first known specimens of the southern subspecies. Previous searches between 23 April and 21 May found nothing (this species is not expected to be flying in that area in late May and my capture of this specimen that day was the result of an actual miracle – which I would be glad to tell anyone about privately). I have collected and observed this population several times between 1977 and 1991. I have also reared specimens of the Aiken colony twice (Figs. 13-16) verifying the unique characters of this population. Today, the site remains as it was when I first located it. .

The first person to consider describing this subspecies was Steve Roman who lived in the Orlando, Florida area at the time and who, along with Rick Gillmore, had the most experience with, and was thus the most knowledgeable of, this taxon in Florida. Roman subsequently gave up studying Lepidoptera (he later became interested in certain Coleoptera). About that same time I began working on this present paper dealing with all the southern *Mitoura* and had a rough manuscript completed by the fall of 1979. This was to be part of a series of papers on several southeastern hairstreaks. Business and personal matters put all this on hold. Next, Dave Baggett began to investigate this taxon and moved close to producing a paper. At one point we talked of doing this together. Several factors eventually came into play in his life that kept him from moving forward. Thus it is that I have been sitting on this description, in various stages of completion, for about 20 years.

The only real decision has been in determining the ranges of the two subspecies. Baggett felt the populations in Florida and south Georgia (discovered by Irving Finkelstein) were the definitive subspecific entity. I strongly disagreed. The new subspecies is only slightly more phenotypically developed and averages a little larger in Florida but as an evolutional entity the subspecies clearly includes the population in extreme southwestern South Carolina. Subspecies *angulata* exhibits far less variation from southern South Carolina to north Florida than nominate *hesseli* exhibits from Maine to Virginia. *Angulata* may be present in Sumter County, South Carolina as there is a large stand of *C. thyoides* there. Unfortunately, it lies in the bombing range of the Shaw Air Base and can not be accessed – even though in a State Forest.

### *Mitoura hesseli angulata* Gatrelle, new subspecies

**Description and diagnosis.** (Figs. 9-18). The primary distinguishing features between the northern (nominate) and southern subspecies (*angulata*) are the markings on, and the ground color of, the ventral hindwings. Secondarily, *angulata* is distinguished by its longer tails, larger size and tendency to have more fulvous scaling on the dorsal forewings. Other than the sex patch of the males, the sexes of each respective subspecies are marked and colored alike with the respective females being somewhat larger and with longer tails than their males. In nominate *hesseli* (Figs. 1-8) the ventral ground color is typically a vivid olive green, in subspecies *angulata* it is dark green to dark brown. In nominate *hesseli* the ventral white marginal line is often wide from M1 to the anal angle and blends into the submarginal area peppering it with many white scales; in subspecies *angulata* this line is thin and the submarginal area much less invaded with white scaling. The ventral hindwing median line in *angulata* is much more undulate than in nominate *hesseli;* the spots in this line on *angulata* are very angulate also while in northern *hesseli* they are more curved and give a softer appearance. The last two spots in this line in cell CU2 and A2 are diagnostic of *angulata* and form, what Baggett aptly called, a sickle shape; in northern *hesseli* these

lines usually tend to form a soft **m** shape. In *angulata* the lower of the two ventral hindwing basal spots is usually in the form of a sharp arrow-head pointed outward, this is mirrored by an inward pointing arrowhead in the median line in cells M1, M2; nominate *hesseli* lacks this feature. In cells M3 and CU1 the spots in the median band on *angulata* are often very reduced in size – almost absent; in nominate *hesseli* they may be only slightly reduced. On the dorsal surface, *angulata* has red fulvous scaling in some specimens, becoming more frequent the farther south the subspecies is encountered, there is red scaling on 6 of the paratypes (20%) but strongly in only two.

**Types.** All: SOUTH CAROLINA, Aiken County, nr Aiken State Park (leg. R. Gatrelle). *Holotype* ♂ (Figs. 15-16): ex ova 4 May 1990, ex pupa 19 June 1990. *Allotype* ♀ (Figs. 17-18): 20 April 1990. *Paratypes*: 14♂♂, 16♀♀: 1♀, 21 May 1977; 4♂♂, 1♀, 21 April 1983; 4♂♂, 1♀, 21 April 1984; 1♀, 25 July 1988; 1♀, ex ova 27 April - ex pupa 9 June, 1♀, ex ova 2 May – ex pupa 24 June 1989; 3♂♂, 20 April 1990; 1♀, 29 April, 3♂♂, 9♀♀, ex ova 2 May – ex pupa 12 to 18 June 1991. All type specimens are currently housed in the TILS Museum of the Hemispheres, Goose Creek, South Carolina. It is planned that some of the paratypes will be deposited in another Museum to be determined later.

**Type locality.** Aiken County, South Carolina.

**Etymology.** This subspecies derives its name from the angular nature of the median bands on the ventral hindwings.

**Remarks**. It is significant that in the southern subspecies of *grynea* the ventral median line becomes straighter and the basal markings bars, dots or obsolete, while in the southern subspecies of *hesseli* these same characters become more angular and undulate. Opposite patterns like this, especially in closely related species, indicate that they are strictly genetic in origin. In contrast, it is usual for southern hairstreak subspecies in the eastern U.S. to exhibit more dorsal fulvous and longer tails than their northern counterparts – typical of environmentally induced morphological characters. The second brood of *M. hesseli angulata* is darker below than the spring brood with most specimens being a deep brownish green in ground color. I have seen many specimens from Florida in the private collections of Steve Roman, Rick Gillmore and Jeff Slotten.

It is very significant that I have reared both the Aiken (South Carolina) colony of *angulata* (Fig. 14) and the Hoke (North Carolina) colony of *hesseli* (Fig. 5) twice each. These where reared under the same conditions (indoors) at the same location (Goose Creek, SC) with each producing 100% distinctly different subspecific phenotypes demonstrating that the populations are two genetically distinct morphological subspecies.

Baggett (personal communication) was interested in the fact that he had found evidence in the plant literature that the larval host of *angulata* in Florida was considered by some as a distinct variety of *Chamaecyparis thyoides* and that this might indicate that *angulata* evolved in concert with this variety of *C. thyoides*. This is worthy of future study. I have noted several other stands of White Cedar in Aiken County (via binoculars) but have not been able to access these sites as they are well into private property. *Mitoura hesseli angulata* is quite uncommon in nature and very under-represented in collections. It should be considered a taxon of special concern. The population in Aiken County is the only known colony in South Carolina. This colony is located on a utility easement on private property. While *angulata* may well occur at other locations within South Carolina, this should not be assumed from a wildlife management standpoint. I have found that *hesseli* colonies are most numerous where the old trees have been logged and young trees are in thick stands of 5 to 30 feet tall saplings.

There were five other specimens I had photographed and originally intended to include in this paper but there was not enough room for them on the plate and they have been omitted. These were two unique wild caught aberrant individuals of *smilacis* and specimens of *grynea* from Mississippi and Iowa. The latter are examples of *grynea* to the west of this study area. All the Mississippi material I have seen from mid to up state is typical *grynea*. I have not seen any from the coastal region of that state. Being from Iowa, I have collected *grynea* at several locations there. These are transitional to more western phenotypes. They tend to have bars at the base of the VHW and lean toward subspecies *M. g. castalis* (W.H. Edwards, 1871).

In recent years various long established *Eumaeini* genera have come to be lumped as subgenera under *Callophrys* Billberg, 1820. This includes the genus *Mitoura*. This does not seem warranted to me. In fact, we are now in a phase where much lepidopteran lumping seems to be going on at all levels – and at times with very little or no published research. For those who have followed this trend, the name *angulata* would be spelled "angulatus" if placed under *Callophrys*.

## ACKNOWLEDGMENTS

I wish to thank Niklas Wahlberg and his wife for translating the Dutch OD of *damon* to English. I thank Steve Roman and Dave Baggett for thoughts shared years ago relative to the subspecific status of this southern taxon. I thank Don Lafontaine for supplying me with various original descriptions and color copies of *damon* in particular. I also thank the late J. F. Gates Clark who, while at the USNM, supplied me with the original description of *smilacis* and a color photograph of that plate. As stated in the text, my work on this paper goes back many years.

## LITERATURE CITED


BOISDUVAL, J.A., & J.E. LECONTE. 1833. Historie générale et iconographie des Lépidoptères et des chenilles de l'Amérique Septentrionalis. Vol. 1. Paris. 228 pp.

CALHOUN, J.V. 1997. Updated List of the Butterflies and Skippers of Florida. Holo. Lepid. 4(2): pgs. 39-50. Gainesville, Fl.

FORBES, W.T.M. 1960. Lepidoptera of New York and Neighboring States, part 4. Cornell Univ. Agr. Exp. Sta. Memoir 371, 188 pp.

FREEMAN, H.A. 1952. Field and Lab., 20: 30.

GATRELLE, R.R. 1998. An Addendum to *Anthocharis midea* dosPassos and Klots 1969 (Description of a New Subspecies from Texas). The Taxonomic Report Vol. 1, No 1, TILS, Goose Creek, SC. 5 pp.

----------. 1999. Three New Hesperioidae (Hesperiinae) from South Carolina: New Subspecies of *Euphyes bimacula, Poanes aaroni,* and *Hesperia attalus*. The Taxonomic Report Vol. 1, No 10, TILS, Goose Creek, SC. 13 pp.

---------- . 2001. An Examination of Southeastern U.S. *Satyrium* (Lycaenidae: Theclinae). Part One: An Obscure New Subspecies of *Satyrium edwardsii*. The Taxonomic Report Vol. 3, No 2, TILS, Goose Creek, SC. 7 pp.

HÜBNER, J. 1819. Verz. bekannter Schmetterlinge. Augsburg. Pg. 74.

JOHNSON, K. 1991. Types of Neotropical Theclinae (Lycaenidae) in the Museum National d'Histoire Naturelle, Paris. Journal of the Lepid. Soc., Vol. 45(2): pgs. 142-157.

RADFORD, A.E., H.E. AHLES & C.R. BELL. 1968. Manual of the Vascular Flora of the Carolinas. Univ. of North Carolina Press, Chapel Hill. 1183 pp.

ROBBINS, R.K. 1990. The *Mitoura spinetorum* Complex in New Mexico and the Validity of *M. millerourm* (Lycaenidae: Theclinae). Journal of the Lepid. Soc. Vol. 44(2): pgs. 63-76.

STOLL (in CRAMER). 1782. Uitl. Kapellen, Vol. 4: pg. 208.


---


# *The Taxonomic Report*

is a publication of ***The International Lepidoptera Survey (TILS).***

(A Tax Exempt Non-Profit Scientific Organization )

***The Taxonomic Report*** is projected for publication at the rate of 8-10 issues a year. Subscription/ dues for Volume Three are $45 US for domestic and $55 US for overseas subscribers. The subscription year follows the calendar year. All issues are mailed 1st class. At the end of each year, subscribers receive that year's volume on a record-only compact disc (CDR) for permanent archiving and reproduction for personal use (i.e. a museum or university may make as many copies as needed in whatever format desired). Non-members may receive individual issues in print any time for $10 per issue. Individual issues on CDR to non-members are $25 per issue post paid. **Subscriptions** and **individual issue** orders should be made payable to **TILS;** and **mailed to:** Treasurer, 126 Wells Road, Goose Creek, SC USA 29445-3413.

Catch us on the web at: **www.tils-ttr.org**

Volume 3 28 December 2001 Number 5

The Taxonomic Report
OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# Initial Survey of the Butterflies and Skippers in the Vicinity of the Buck Creek Serpentine Barrens, Clay County, North Carolina.

Conducted by the International Lepidoptera Survey for the US Forest Service. May – October 2001

## SUMMARY

*General.* Serpentine barrens are generally low in biotic diversity. However, these barrens are known to frequently harbor unusual species of plants and animals not usually found elsewhere. A survey was conducted from 4 May through 2 October 2001 in and around the Buck Creek Barrens located in Clay County, North Carolina to document the butterfly and skipper taxa present at this location and their status. The site was visited 15 times during this period with at least two visits each month except September and October. A total of 76 different taxa were located with another 14 being likely (90 total). Two new state records were recorded, one new mountain record and several unusual species. One of the two new state records is an undescribed species and the other a possible undescribed subspecies.

*Species status.* Throughout the Southern and Eastern United States the 2001 season was characterized by unusually low numbers of most species. In many areas even usually common species were found in low numbers. Because 2001 was an unusual year for population density, it is not possible to give an accurate assessment of the "normal" levels for many taxa found in the 2001 survey. But because the primary researcher is an expert field lepidopterists with several years of experience with western North Carolina taxa, an educated projection is given for most taxa recorded.

*Barrens area.* It is our opinion that the barrens area once supported a much more robust and diverse butterfly and skipper fauna then it does today. We find the area in poor health and in much need of increased management and in a manner that caters more to invertebrates. Burns are needed but should be limited in size as the rarer species seem to not be evenly distributed throughout the barrens area. More and smaller burns are recommended in a grid manner rather than on entire slopes at a time. We also recommend the thinning and removal of trees on the periphery of the serpentine areas to help provide a buffer and transitional perimeter.

## AREAS SURVEYED

The survey site was segmented into four areas. 1) East Barrens. This area is on the east side of FS Road 350 up the west facing slope to just above FS Road 6269. 2) West Barrens. This area is on the west side of FS Road 350 and extends in an irregular pattern up the east facing slope parallel to road 350 to the junction of FS Road 350A. A power line cut runs the length of this area. In the southern portion of this section the barrens habitat goes to the top of the ridge. The power line cut connects the West Barrens to the next area. 3) Meadow at the old church property end of FS Road 350A. Though man made, this meadow functions as an extension of the West Barrens due to the flyway created by the power line cut. This area should be maintained as an integral part of the Barrens system. 4) Surrounding area. The area of Hwy 64 at the eastern junction with old 64 where there are large open areas; Hwy 64 between east and west junctions of old 64; up FS Road 6237. These surrounding areas act as man made habitat reservoirs where several of the grass/sedge feeding species of the Barrens have found suitable habitat that is now less available in the Barrens areas. Areas to the north are too forested to support Barrens specific taxa.

## SURVEY DATES AND METHOD

The survey area was visited the following dates. May 4, 10, 14, 18, 29; June 18, 29; July 6, 16, 31; August 10, 21, 28; September 18; October 2. The time of each daily survey was basically the same. The day usually began between 08:30 and 09:30 and ended between 16:30 and 19:00 depending on day length and weather. Weather was good to excellent on all dates – morning fog was the biggest factor. A set pattern was established and followed each of these days. Area 3 was always visited first as it received the most morning sun enabling species to fly there much earlier than the other areas. Area 3 was left between 11:00 and 12:00 each visit. Area 2 was surveyed next ranging from about 11:00 to 14:00. Area 1 was surveyed last as it only had full sun from noon onward. The beginning time in area 1 varied from 12:00 to 13:30. Depending on what taxa were located in the initial round of daily searches, the three areas were surveyed again with the most time spent in the most fruitful area on a given day. The area 4 peripheral sites were checked sporadically with the large open area at the eastern junction of old and new highways 64 being visited most frequently as it was the exit route from the Buck Creek site. This part of area 4 had the latest sun which provided the opportunity for even early evening surveying in mid summer.

## VERIFIED SPECIES LIST

| NAME | AREA | | | | DATE | STATUS |
|---|---|---|---|---|---|---|
| **HESPERIIDAE** | **1** | **2** | **3** | **4** | **Month - day/day/day** | **occurrence** |
| 1 *Epargyreus clarus* | X | X | X | X | all 15 dates | abundant |
| 2 *Thorybes bathyllus* | | X | | | 8-21 | undetermined |
| 3 *Erynnis icelus* | X | X | X | X | 5-04/10/14/18/29; 6-18/29; 7-06 | abundant |
| 4 " *brizo* | X | X | X | X | 5-10/14/18/29 | abundant |
| 5 " *juvenalis* | X | X | X | X | 5-04/10/14/18/29 | abundant |
| 6 " *horatius* | X | X | X | X | 8-10/21 | common |
| 7 " *baptisiae* | | X | X | | 7-31; 8-10/21 | common |
| 8 " *lucilius* ? | | | X | | 7-16; 8-10 | rare |
| 9 *Pyrgus communis* | X | | | X | 10-02 | undetermined |
| 10 *Nastra lherminier* | X | X | X | X | 7-31; 9-18; 10-02 | not uncommon |
| 11 *Lerema accius* | X | | X | X | 7-16/31; 8-10/28; 9-18; 10-02 | uncommon |
| 12 *Ancyloxypha numitor* | X | X | X | | 5-29; 8-28; 10-02 | uncommon |
| 13 *Hylephila phyleus* | X | X | X | X | 7-31; 9-18; 10-02 | not uncommon |
| 14 *Polites peckius* ssp. | X | X | X | X | 8-10/21/28; 9-18 | common |
| 15 " *origines* | X | | X | X | 6-18/29; 9-18; 10-02 | undetermined |
| 16 *Pompeius verna* | X | X | | X | 8-10; 9-18 | uncommon |
| 17 *Atalopedes campestris huron* | X | X | X | X | 8-10/21/28; 9-18; 10-02 | common |
| 18 *Atrytone logan* | X | X | X | X | 7-06/16/31 | not uncommon |
| 19 *Euphyes vestris metacomet* | X | | X | X | 7-16; 9-18 | uncommon |
| 20 *Atrytonopsis hianna* | | X | | | 5-14 | rare ? |
| 21 *Amblyscirtes hegon* | X | X | X | | 5-10/14 | common |
| 22 " *vialis* | X | X | | X | 5-10/14/29 | not uncommon |
| 23 *Panoquina ocola* | | | | X | 9-18; 10-02 | undetermined |

| PAPILIONIDAE | 1 | 2 | 3 | 4 | Month-day/day/day | occurrence |
|---|---|---|---|---|---|---|
| 1 *Pterourus glaucus* | X | X | X | X | 5-04/10/14/18/29; 6-29; 7-06/16/31; 8-10/21/28; 9-18; 10-02 | abundant |
| 2 *Pterourus* new species | X | X | X | X | 5-10/14/18/29; 6-18 | abundant |
| 3 *Pterourus troilus* | X | X | X | X | 5-04 through 9-18 | not uncommon |
| 4 *Papilio polyxenes asterius* | | X | X | | 5-10; 7-31; 8-21 | undetermined |
| 5 *Battus philenor* | X | X | X | X | 5-29; 6-18/29; 7-31; 8-10/21/28; 9-18 | common |
| **PIERIDAE** | | | | | | |
| 1 *Pieris rapae* | X | | X | X | 5-14/29; 7-16; 8-21; 9-18 | uncommon |
| 2 " *virginiensis* | X | X | X | X | 5-04/10/14/18/29 | abundant |
| 3 *Anthocharis midea annickae* | | X | X | | 5-04 | undetermined |
| 4 *Colias philodice* | X | | X | X | 5-29; 6-18; 7-06; 9-18; 10-02 | common late |
| 5 " *eurytheme* | X | X | X | X | 5-04/10/29; 6-18/29; 7-06/31;8-21; 9-18; 10-02 | not uncommon |
| 6 *Phoebus sennae eubule* | | X | X | X | 5-14; 9-18; 10-02 | occasional |
| 7 *Eurema lisa* | | | | X | 9-18 | undetermined |
| 8 " *nicippe* | X | | X | X | 6-29; 8-10/21; 9-18 | occasional |
| 9 *Nathalis iole* | | | X | | 7-31 | occasional |
| **LYCAENIDAE** | | | | | | |
| 1 *Feniseca tarquinius* | | X | | X | 5-04/10/14 | not uncommon |
| 2 *Satyrium calanus falacer* | X | X | X | | 6-29; 7-06/16/31 | abundant |
| 3 " *liparops* | | | X | | 7-06 | uncommon |
| 4 *Parrhasius m-album* | | | | X | 5-14 | occasional |
| 5 *Deciduphagus henrici* | | | | X | 5-14 | undetermined |
| 6 *Strymon melinus humuli* | X | | X | X | 7-06; 9-18 | uncommon |
| 7 *Calycopis cecrops* | X | | X | | 9-18 | uncommon |
| 8 *Celastrina ladon* | | X | X | | 5-04/10 | undetermined |
| 9 " *neglectamajor* | X | | | X | 5-29 | undetermined |
| 10 " *neglecta* | X | X | X | X | 6-29; 7-06/16/31; 8-10/21 | common |
| 11 *Everes comyntas* | X | X | X | X | all 15 visits | abundant |
| 12 *Glaucopsyche lygdamus* ssp | X | | | | 5-04/10/14 | not uncommon |
| **NYMPHALIDAE** | | | | | | |
| 1 *Euptoieta claudia* | X | | X | X | 6-29 through 10-02 | not uncommon |
| 2 *Speyeria cybele* | X | X | X | X | 6-18 through 10-02 | common |
| 3 " *aphrodite cullasaja* | X | X | X | X | 6-18 through 9-18 | common |
| 4 " *diana* | X | | X | | 7-16; 8-10/21; 9-18 | uncommon |
| 5 *Chlosyne gorgone* | X | X | | | 5-10/14/18 | uncommon |
| 6 " *ismeria nycteis* | X | X | X | X | 5-29; 6-18/29; 7-06 | common |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 *Phyciodes maconensis* | X | X | | X | 5-10/14/18/29 | not uncommon |
| 8 " *tharos* | X | X | X | X | 5-10 through 10-02 | common |
| 9 " *cocyta* ? | X | | | X | 7-06 through 9-18 | undetermined |
| 10 *Polygonia comma* | X | X | X | | 5-10/29; 7-06/16; 9-18 | uncommon |
| 11 " *interrogationis* | X | X | X | X | 5-10/14/18; 7-06/1631; 8-10; 9-18 | not uncommon |
| 12 " *progne* | | | | X | 5-18 | rare |
| 13 *Nymphalis antiopa* | X | X | X | X | 5-29; 7-16; 10-2 | not uncommon |
| 14 *Vanessa atalanta* | X | X | X | X | 5-29; 7-06/16/31; 8-10/21/28 | not common |
| 15 " *virginiensis* | X | X | X | X | 5-10 through 10-02 | common |
| 16 " *cardui* | X | X | X | X | 7-06 through 10-02 | erratic/common |
| 17 *Junonia coenia* | X | X | X | X | 5-10/29; 6-29; 7-06 through 10-02 | not uncommon |
| 18 *Limenitis archippus* | X | X | X | X | 5-29; 6-18/29; 7-16 | uncommon |
| 19 " *arthemis astyanax* | X | X | X | X | 5-29; 6-29; 7-16; 8-21/28 | common |
| 20 *Agraulis vanillae nigrior* | X | | X | X | 9-18; 10-02 | occasional |
| 21 *Enodia anthedon* | | | X | X | 6-18; 8-10 | uncommon |
| 22 *Satyrodes appalachia* | X | X | X | | 6-29; 7-16/31 | not uncommon |
| 23 *Cercyonis pegala carolina* | X | X | X | | 7-31; 8-10/21/28; 9-18 | very common |
| 24 *Megisto cymela* | X | X | X | X | 7-06/16/31 | not uncommon |
| 25 *Hermeuptychia sosybia* | X | X | X | | 6-18/29; 7-06/31; 8-10/28; 9-18 | not common |
| 26 *Cyllopsis gemma* | | X | X | | 6-29 | uncommon |
| **DANAIDAE** | | | | | | |
| 1 *Danaus plexippus* | X | | X | X | 7-31 through 10-02 | common |

## PROBABLE AND ADDITIONAL SPECIES LIST

Jason Love of the Coweta FS Station tentatively identified a few other species for this site in 2000. Gatrelle also expects a few other species to be likely for the Barrens area. These species are as follows.

| LOVE RECORDS | 1 | 2 | 3 | 4 | DATE | STATUS |
|---|---|---|---|---|---|---|
| 1 *Hesperia sassacus* | | ? | | | 5-29 | possible |
| 2 *Erynnis zarucco* | ? | ? | | | 7-16 | probable |
| 3 *Wallengrenia egeremet* | ? | ? | | | 9-10 | probable |
| 4 *Deciduphagus augustinus* | ? | ? | | | 4-16 | very probable |
| **EXPECTED** | | | | | **WHEN FOUND** | |
| 5 *Polites Themistocles* | X | X | X | X | May-June and August-September | very probable |
| 6 " *vibex* | X | X | X | X | June to August | very probable |
| 7 *Poanes zabulon* | X | X | X | X | May-June and August-September | very probable |
| 8 " *hobomok* | X | X | X | X | May to July | very probable |
| 9 *Wallengrenia otho* | X | X | X | X | June to August | possible |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 *Celastrina nigra* | X | X | | X | late March into May | very probable |
| 11 *Deciduphagus irus* | X | X | X | | May into June | possible |
| 12 *Incisalia niphon* | X | X | | X | mid April through May | very probable |
| 13 *Satyrium edwardsii* | X | | X | X | June-July | probable |
| 14 *Polygonia faunus smythi* | X | | | X | June to August | probable |

## SPECIAL COMMENTS

Six taxa are of special interest.

1) A new species of Swallowtail in the genus *Pterourus* is in the process of being described. This species seems endemic to the Appalachian region. The Buck Creek site will be its type locality. This species is univoltine and flies from mid spring to early summer. In the below picture, the top two individuals are the common Eastern Tiger – *Pterourus glaucus glaucus*, the two lower individuals are the new species. Black females are not known in the new species while they are dominant in *glaucus* (at Buck Creek). As can be seen, these sympatric Buck Creek species are most easily told apart by size in the males.

2) *Chlosyne gorgone gorgone* is known from only two locations – one in Georgia and one in South Carolina. It is a univoltine species of the Sandhills region. Other populations are known from the foothills regions of northern Georgia and South Carolina. It has been determined that these multivoltine upstate populations are not the nominate subspecies and have tentatively been referred to subspecies *carlota* (which is a Midwestern taxon). A unique population of *C. gorgone* was found at the Buck Creek barrens. (This colony is 2500 feet higher than the Georgia/South Carolina foothills colonies.) This is a new North Carolina state record and the only known record of *gorgone* in the Appalachian mountains (an old 1800s West Virginia record is uncertain). Gatrelle will collect a small series of this population as it is possibly an undescribed relict subspecies – and hopefully work out its local life history in 2002. The population seems to be well established at this site in both the east and west barrens areas. This is by far the most unique taxon at this site.

3) *Phyciodes batesii maconensis* (Appalachian Crescent) is at times a common butterfly throughout the survey area. This North Carolina/Georgia southern Appalachian endemic (described by Gatrelle in 1998 from Macon County, North Carolina) has now undergone mtDNA analysis (by Dr. Wahlberg) against nominate *batesii* of the northeastern US and eastern Canada. It has been determined that the mtDNA of these two taxa are very different. This means that *maconensis* is possibly a species distinct from *batesii*. It is so treated by Gatrelle in this paper – *Phyciodes maconensis* (new combination).

4) One specimen of *Polygonia progne* (Grey Comma) was found along old Hwy 64. This may be the southernmost record for this typically northern species. This specimen may have been a stray but this is doubtful as it was found early in the year and was in poor condition. This indicates that it was bred in the area and overwintered there. This taxon is very unusual in North Carolina. It may well have a colony in the survey area including the stream bottom that divides the east and west barrens.

5) One freshly emerged male specimen of *Atrytonopsis hianna* was found in the West Barrens. This is a new North Carolina mountain region record for this species. Jason Love recorded *Lerema accius* from this same area on April 16, 2000. It is Gatrelle's opinion that this is in fact a misidentification of *hianna*. Love did not voucher his record, and these two can look very similar to an inexperienced lepidopterist. This is the second most unique taxon in the barrens.

6) Five *Erynnis* Skipper specimens were collected in the area 3 meadow and tentatively determine to be species *lucilius*. This determination was made by dissecting the male genitalia and comparing the adults with reared specimens of *lucilius* from West Virginia. (Reared by Tom Allen.). The problem is that the larval host, Columbine (*Aquilegia canadensis*), was not located by Gatrelle in the immediate area. This host needs to be documented in this vicinity. If plants of this host are found, a search should be made for *lucilius* larvae on these plants to confirm this record. *E. baptisiae* is an almost cryptic sibling species to *lucilius*. *Erynnis lucilius* is a unique species for North Carolina and its status there needs a lot of detailed survey work.

In conclusion, this survey is but a beginning. The Lepidoptera found to date in this initial survey reveals that much more work and analysis needs to be conducted in this unique Serpentine Barrens and the adjoining areas.

---

Survey conducted by Ronald R. Gatrelle, president, The International Lepidoptera Survey.
Report submitted December 27, 2001. Financial support provide by the US Forest Service.

Volume 3 15 May 2002 Number 6

The Taxonomic Report
OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# NAME-BEARING TYPES AND TAXONOMIC SYNOPSIS OF THREE LYCAENID BUTTERFLY TAXA FROM WESTERN CANADA (LEPIDOPTERA: LYCAENIDAE)

NORBERT G. KONDLA[1]
P.O. Box 244, Genelle, BC V0G 1G0 Canada

AND

CRISPIN S. GUPPY
4627 Quesnel-Hydraulic Road, Quesnel, BC V2J 6P8 Canada

**ABSTRACT:** We clarify which of two designated lectotypes of *Chrysophanus florus* Edwards, 1884 is valid. We also show that the putative holotype of *Plebeius saepiolus insulanus* Blackmore, 1920 is actually a lectotype. A valid neotype designation for *Lycaena saepiolus amica* Edwards, 1863 is provided. Publication dates are corrected and we also briefly review the various taxonomic interpretations and distributions that appear in the literature with respect to these taxa.

**Additional key words:** *Plebejus*, *Aricia*, *Epidemia*, *dorcas, helloides, kodiak, rufescens,* Alberta, British Columbia

## INTRODUCTION

The first purpose of this article is to clarify the name bearing type of the butterfly *Chrysophanus florus* Edwards, 1884. This is necessary because two lectotype designations have been published and two butterflies with lectotype labels exist in the Canadian National Collection of Insects and Arthropods (CNC, Ottawa, Canada). Our second purpose is to clarify the name bearing type of *Plebejus saepiolus* race *insulanus* Blackmore, 1920. This is necessary because the existing name bearing type is erroneously labeled as a holotype in the CNC. We also report the correct publication years for these two taxa. Thirdly, a valid neotype designation for *Lycaena saepiolus amica* is presented. This is necessary because the neotype designation by Brown (1970) is invalid. We also give an overview of the numerous and unresolved taxonomic interpretations related to these butterflies. Our overall purpose is to set the stage for subsequent taxonomic review.

### *Chrysophanus florus* Edwards, 1884 (Figures 1 and 2)

Edwards (1884) described *Chrysophanus florus* as a distinct species. The original description appeared in *Canadian Entomologist* 12(11), which was published 17 January 1884 (Bird and Ferris 1979, Bridges 1988), rather than in 1883 as has generally been assumed (e.g. Miller and Brown 1981, Guppy and Shepard 2001). Two lectotypes have been designated and reside in the Canadian National Collection of Insects and Arthropods. Figures 1 and 2 show the dorsal and ventral views of the two putative lectotypes in the CNC.

---

[1] Research Associate, The International Lepidoptera Survey, Goose Creek, South Carolina.

Brown (1969) published the first lectotype designation. He selected the lower specimen shown in Figures 1 and 2 for his lectotype but clearly showed that it was not from the type series (syntypes). A lectotype may only be selected from the type series, pursuant to the International Code of Zoological Nomenclature (henceforth, "the Code") Article 74 (International Commission on Zoological Nomenclature 1999). It is clear from Brown (1969) that Edwards did not have available to him the specimen Brown selected as the lectotype and hence the lectotype designation by Brown is not valid. As noted by Brown (1969), Edwards only saw one or two of Geddes' *L. florus* specimens and returned them to Geddes (the collector of the types). Also as noted by Brown (1969), none of the four Geddes *L. florus* specimens from Calgary in the CNC carry an Edwards label but two specimens from Crowsnest Pass do carry Edwards labels. Those two specimens are therefore the type series. We recommend that a label be added to the "lectotype" labelled by Brown (1969) stating that it is not a lectotype, along with a citation of this article for the benefit of future researchers who access these specimens.

Bird and Ferris (1979) designated the second lectotype. Their lectotype designation is the valid lectotype designation but not for the reasons they present in their paper. They express the view that the Brown lectotype designation is invalid because of an error in the type locality as provided by Brown. In

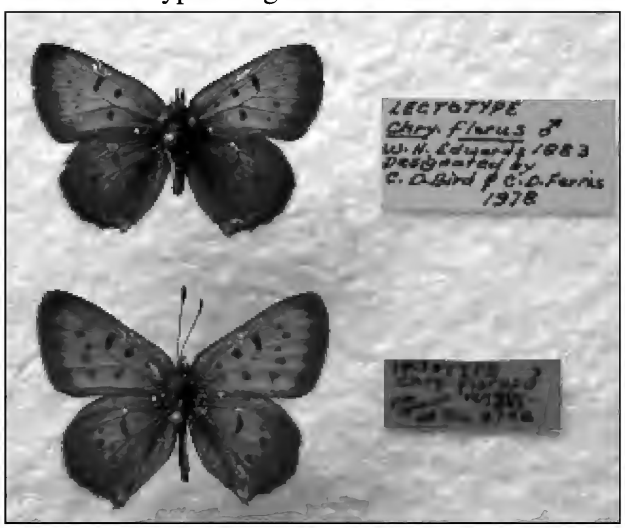



**Figure 1.** Dorsal view of the two *florus* "lectotypes" in the CNC. Photo: N. Kondla

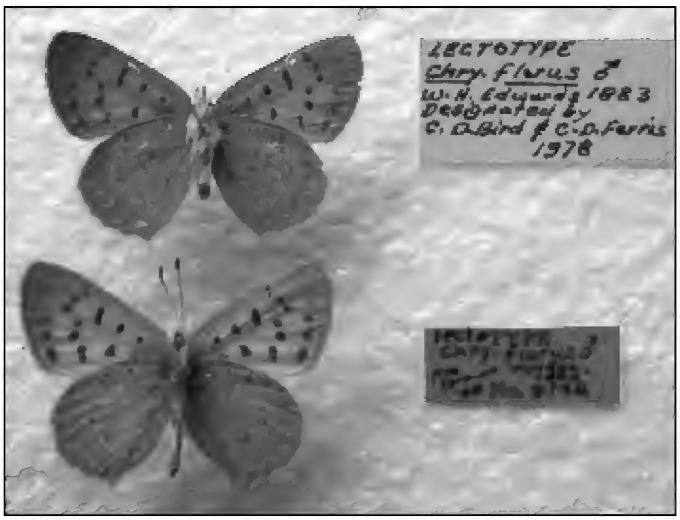



**Figure 2.** Ventral view of the two *florus* "lectotypes" in the CNC. Photo: N. Kondla

**Figure 3.** Dorsal view of the putative *insulanus* "holotype" (now a lectotype) in the CNC. Photo: N. Kondla

**Figure 4.** Ventral view of the putative *insulanus* "holotype" (now a lectotype) in the CNC. Photo: N. Kondla

fact, the 'correctness' of a type locality has no bearing on the validity of a lectotype. There is no Code requirement for a lectotype to have a 'correct' type locality. The type locality does not determine the lectotype; it is the lectotype that determines the type locality (Article 76.2 of the Code). However for the reasons explained above, we also conclude that the Brown lectotype is invalid and hence Bird and Ferris (1979) were justified in designating a new lectotype. The Bird and Ferris lectotype is valid because it was selected from the type series.

The type locality of *L. florus* was referenced as Red Deer River, and restricted to Didsbury, Alberta by Brown (1969) and by Miller and Brown (1981). Both this type locality and the alleged type locality restriction is incorrect. Brown (1969) did not restrict the type locality but rather alleged that "Garrett's Ranche, Br. Amer." is now called Didsbury. Brown (1969) quoted the type locality as "Taken on Red Deer River, Br. Am.". We note that the Red Deer River is more than 80 kilometres from the town of Didsbury. Type locality confusion was further increased because the lectotype selected by Brown (1969) was collected near Calgary, which should have been cited as the type locality until the lectotype designation by Bird and Ferris (1979). All three of these alleged type localities are incorrect. The valid lectotype designation by Bird and Ferris (1979), along with the historical and geographical research reported therein, means that the type locality of *L. florus* is "Garnett's Ranch, near Lundbreck, mouth of Crowsnest Pass, Alberta".

The taxon *florus* has variously been placed in the literature as a subspecies of *Lycaena* (*Epidemia*) *dorcas* or as a subspecies of *Lycaena* (*Epidemia*) *helloides* (eg. Ferris 1977, Scott 1978), although Klots (1931) argued that *L. dorcas* and *L. helloides* are the same species because they have similar male genitalia. Various books have not contributed anything to resolution of this matter and have even contributed to confusion about the distribution of *L. florus* (eg. Layberry et al. 1998, Opler 1999). Bird et al. (1995) correctly described the Alberta distribution as being confined to the extreme southwest of the province. The status of *L. florus* in southern British Columbia is under review. It was not included in Guppy and Shepard (2001), although it is reported from British Columbia by Ferris (1977) and numerous specimens of phenotypic *florus* are known from southern British Columbia. Opler (1975: 314) expressed the view that high altitude *florus* populations in Colorado appear intermediate between *dorcas* and *helloides* but did not explain the perceived characters that resulted in such a view. Kohler (1980, pers. comm.) recognises *L. helloides* and *L. florus* as different taxonomic entities in Montana on the basis of phenotypic, phenological and ecological differences. A review of the specimens in the CNC by Kondla in 1998 and by Guppy in 2002 support the interpretation that *L. helloides*, *L. dorcas*, and *L. florus* all occur in Alberta as distinct species. Recent literature has seemingly been based on the unstated assumption that the taxon *florus* must be associated at the species level with either *dorcas* or with *helloides*, as pointed out by Kondla (1999). Nothing has been published to support treating *florus* as anything other than the full species that Edwards described it as. Clarity on the name bearing type is needed regardless of the differing taxonomic interpretations.

***Plebeius saepiolus* race *insulanus* Blackmore, 1920 (Figures 3 and 4)**

Blackmore (1920) described *Plebeius saepiolus* race *insulanus*, although the publication date has apparently always been stated in error to be 1919 (eg. Miller and Brown 1981; Guppy and Shepard 2001). The *Proceedings of the Entomological Society of British Columbia* were at that time normally published the following year, as was the case for the 1919 *Proceedings* (Bridges 1988). Further evidence for publication in 1920 is contained within the original description itself. The last three paragraphs are preceded by the words "AUTHORS NOTE (October, 1920)". Since then the species *saepiolus*, with its subspecies *insulanus*, has been traditionally placed in the genus *Plebejus* or its variant spelling *Plebeius*. Detailed explanation of the *Plebeius/Plebejus* spelling variants is provided by Bálint et al. (2001), who also invoke Article 24.2 of the Code to make *Plebejus* the code-compliant spelling.

Bálint and Johnson (1997) provide reasons based on genitalic structure for preferring use of the generic name *Aricia* for the species *saepiolus*. The genus *Aricia* was named after the town of Aricia in Latium on the Via Appia (Traupman, 1970) and is feminine. Brown (1951) incorrectly used the spelling *insulana* for the taxon *insulanus*, in combination with the masculine *Plebeius/Plebejus*. Use of the feminine spelling *insulana* in combination with the genus *Aricia* would also be an error. The Latin word insulanus (= an islander) is a noun, and as such Article 31.2.1 of the Code requires the original spelling to be retained, with gender ending unchanged. Gender agreement for species group names applies only if the name is a Latin or latinized adjective or participle in the nominative singular. Readers should also resist the temptation to change *saepiolus* to *saepiola* when placed in the genus *Aricia*, because the Latin word saepiolus is also a noun.

Blackmore did not designate a holotype in his 1920 paper, but three years later re-described the taxon *insulanus* and this time did designate a holotype (Blackmore 1923). Unfortunately this belated holotype designation is invalid, because Article 73 of the Code requires that a holotype designation be part of the original description of a taxon. A holotype can only be designated at the time of original description, thus the "holotype" designated by Blackmore (1923) is not a valid holotype. Code Articles 74.5 and 74.6 render the putative holotype a legitimate lectotype. We recommend to the CNC, as custodians of the type specimen, that a lectotype label be added to the specimen, along with a citation of this article for the benefit of future researchers. The dorsal and ventral views of the lectotype of *Plebeius saepiolus* race *insulanus* Blackmore, 1920 (type locality: Victoria, BC) are shown in Figures 3 and 4.

***Lycaena amica* Edwards, 1863 (Figures 5 and 6)**

The taxon *amica* was described as a full species by Edwards (1863). The type locality of *amica* Edwards is Fort Smith, NT by virtue of our neotype designation (below) and not Fort Simpson as erroneously listed in recent literature including Brown (1970). The original description gave "From Mackenzie's River" as the type locality. Brown gave no reasons for arbitrarily saying that Fort Simpson is the type locality. Brown asserted that Fort Smith is upstream of Fort Simpson but this is incorrect. Fort Smith is located on the Slave River, which is separated from the Mackenzie River by Great Slave Lake.

Unfortunately Brown's neotype designation is not compliant with the fourth edition of the International Code of Zoological Nomenclature. The fourth edition of the Code requires a valid neotype designation to be published with "a statement that it is designated with the express purpose of clarifying the taxonomic status or the type locality of a nominal taxon" (Article 75.3.1). Brown's designation does not meet this test. The fourth edition of the Code supersedes all previous editions so this deficiency adequately demonstrates that the Brown neotype designation is invalid. To some this may seem to be a minor reason to invalidate Brown's neotype designation. However it is critical to avoid the selective rejection of portions of the Code, based on personal opinion of "importance", in the interest of taxonomic stability and consistency.

However, for the benefit of readers who mistakenly think that compliance with the version of the Code in effect in 1970 renders the Brown designation valid; we test the designation against the provisions of the second edition of the Code, which was in effect in 1970. The second edition of the Code required neotypes to only be designated in connection with revisory work and then only in exceptional circumstances (e.g. a complex zoological problem) when a neotype is necessary in the interests of stability of nomenclature. Brown did not designate the neotype as part of revisory work. He presented no exceptional circumstances that warranted a neotype. His stated motivation for designating a neotype was that the original description was very brief and left much to be desired and thus he felt obliged "to settle the question of *amica*'s identity". Thus, Brown's neotype designation was also invalid under the Code version in effect at the time.

We remedy this situation by validly designating Brown's putative neotype of *amica* as the neotype in accordance with the International Code of Zoological Nomenclature. The designation is organized in accordance with the Code neotype articles to clearly demonstrate compliance with the Code provisions:

- Article 75.1 – We believe that a name bearing type is necessary to define the nominal taxon objectively. We present below the numerous and conflicting and unsubstantiated interpretations surrounding the name *amica* and related names.
- Article 75.3 – We believe that there is an exceptional need to establish a name bearing type to allow for resolution of the various published and conflicting taxonomic interpretations surrounding *amica* and related names.
- Article 75.3.1 – We designate the neotype with two express purposes. One purpose is to establish Fort Smith, Northwest Territories, Canada as the type locality of the taxon *amica*. The second purpose is to clarify that we view *amica* as a distinct taxonomic entity from the taxa *insulanus* Blackmore, 1920 and *kodiak* Edwards, 1870.
- Article 75.3.2 – The taxon *amica* differs from *insulanus* by having females that often have blue scaling basad on the dorsal forewing and by being more strongly spotted on the ventral surface. The taxon *amica* is differentiated from *kodiak* by its larger size and lighter, greyish white ventral surface, with smaller spots, in the males.
- Article 75.3.3 – In the interests of stability and to avoid confusion; we designate as the neotype of *amica* the same specimen invalidly designated by Brown (1970). The neotype is a male in the Canadian National Collection of Insects and Arthropods in Ottawa, Canada. It is type number 10908 in said collection. It was collected at Fort Smith, NT by W.G. Helps on 28 June 1950. It is illustrated in black and white by Brown (1970) and is herein illustrated in colour as Figures 5 and 6.
- Article 75.3.4 – We believe that the type specimens of *amica* are lost because Brown (1970) quotes from a letter by Edwards to Holland that they were lost. Types were not located in sundry collections visited by Brown in his research on Edwards types.
- Article 75.3.5 – Brown (1970) presented evidence that the neotype is consistent with what is known of the former name-bearing type from the original description and we cite his paper as evidence herein. We have also compared the original description (Edwards 1863) to the neotype and find that it is consistent.
- Article 75.3.6 – We reference the information in Brown (1970) as evidence that the neotype came as nearly as practicable from the original type locality.
- Article 75.3.7 – The neotype is the property of the Government of Canada and is housed in the Canadian National Collection of Insects and Arthropods, Ottawa, Canada.

**Figure 5.** Dorsal view of the neotype of *amica* in the CNC. Photo: N. Kondla

**Figure 6.** Ventral view of the neotype of *amica* in the CNC. Photo: N. Kondla

**Synopsis of the names attributed to the nominal species *Aricia saepiolus* in western Canada**

With clarity of the types and type localities now in hand; we provide a brief synopsis of the various taxonomic interpretations and distributions presented in the literature since these animals were first described.

Blackmore (1920) limited *insulanus* to Vancouver Island and expressed the view that populations from Atlin in extreme northwestern British Columbia approach typical *saepiolus*. Llewellyn-Jones (1951) also followed this approach. Holland (1931:258, 259) treated *amica* and *insulanus* as full species rather than subspecies of *saepiolus*. Leussler (1935) reported collection of a few specimens from the area of the Mackenzie River delta, NT. He observed that "These are small and come nearest to race *insulanus* Blackmore, but are paler and duller looking above. They fit the description of *amica* Dew. [sic] somewhat indifferently". Brown (1951) recognised nominate *saepiolus* as being present in extreme southern British Columbia; treated Vancouver specimens as *insulanus* and extended application of the name *insulanus*"on the mainland west of the Fraser River in British Columbia (Lillooet)". Brown (1951) further stated that "*Amica* (?) extends eastward from the mountains in western Alberta" and made no comment on the placement of populations in northwestern British Columbia.

Downey (1975:343) assigned *insulanus* to populations from Vancouver Island and western British Columbia, and used *amica* for the remainder of British Columbia with the exception of a comment that nominate *saepiolus* ranges "northward to British Columbia where it gives way to *insulanus*". Scott (1986) reported *insulanus* from southwestern British Columbia, south to northwestern California and east to Montana and used *amica* for the remainder of western Canada. Layberry et al. (1998) restrict *insulanus* to Vancouver Island and attribute *amica* to the remainder of the Canadian range. Shepard (2000) disputes the assignment of coastal Oregon populations to *insulanus* and asserts that Vancouver Island populations are a distinct subspecies found nowhere else in Canada. Guppy and Shepard (2001) restrict *insulanus* to Vancouver Island and apply *amica* to the remainder of BC and even south well into Oregon and east into Alberta and western Montana. This differs from the interpretation of Hinchliff (1994) who assigned Oregon coastal populations to *insulanus* and interior populations to *saepiolus*; and also differs from Hinchliff (1996) who assigned all Washington populations to *saepiolus*. Kohler (1980) assigned all Montana populations to *saepiolus*. Bird et al. (1995) noted that "Most Alberta material can be assigned to *Plebejus saepiolus amica*". Note however that Bird et al. (1995) illustrated a phenotype that is different from that of any named *saepiolus* subspecies. Ferris et al. (1983) assign Yukon populations to *amica*.

Additional uncertainty in subspecies status and geographic boundaries in the northwest is introduced by the taxon *Lycaena kodiak,* described by Edwards (1870). This valid taxon has been essentially ignored in the literature although Holland (1931:263) did note that it was originally described from Kodiak Island and that it "is widely diffused through Alaska and the northwestern parts of British America" [= Canada]. The name may have been ignored because, as Brown (1970) points out, none of the three butterflies he illustrates under the name of *kodiak* are even of the same species as *kodiak.* Brown also notes that other authors have historically misplaced the name *kodiak.* Brown (1970) clarified the status of *kodiak* and designated a lectotype that correctly associates *kodiak* with the species *Aricia saepiolus*. Guppy and Shepard (2001) provide a colour photograph of the male ventral surface of a butterfly that resembles this taxon under the name of *amica*, from Atlin, British Columbia. The taxon *kodiak* is distinguished from *amica* by its smaller size and darker grey ventral surface with more pronounced dark spots.

The taxon *rufescens* has been reported from southern British Columbia (Blackmore 1920, Llewellyn-Jones 1951). This butterfly was described as a full species, *Lycaena rufescens* Boisduval, 1869, but has usually been treated as a female form name (e.g. Comstock 1927, Miller and Brown 1981). A lectotype was designated by Emmel et al. (1998), who also restricted the type locality to Bear Valley, near Olema, Marin County, CA. Emmel et al. (1998) treated *rufescens* as a junior synonym of the subspecies *aehaja* Behr,1867 (type locality: alpine headwaters Tuolumne River, CA); although they gave no rationale for this taxonomic interpretation. In contrast, Austin (1998) presents ample evidence for treating

*rufescens* as a subspecies of *Aricia saepiolus* distinct from *aehaja*; at least in the geographic area he was dealing with. At this time we do not know if *rufescens* is present in British Columbia as a form without standing under the Code or if there are populations that warrant recognition as a species level name under the Code.

Further elaboration and clarification of the *insulanus* component of this confused situation is hindered by the fact that *insulanus* has not been found on Vancouver Island since 1979 (Shepard 2000; specimens in Kondla collection). It may well be extirpated there and future workers therefore are limited to examination of historical material in sundry collections for the purpose of comparing *insulanus* with other taxa. Shepard (2000) itemises the location of approximately 146 specimens of *insulanus* in sundry collections. A search of the Canadian Biodiversity Information Facility website by Kondla revealed the existence of a few additional specimens in the collections of the Nova Scotia Museum of Natural History, the Royal Ontario Museum and the Royal Saskatchewan Museum. There are likely still additional specimens in various museums and private collections, including specimens collected by Richard Guppy who supplied Vancouver Island butterflies to numerous collectors over many years. We would welcome notification of the details of such additional specimens.

We provide photographs of two series of *insulanus* held by the CNC as an aid to future researchers of *saepiolus* taxonomy. Figures 9 and 10 show dorsal and ventral views of *insulanus* from the type series and the vicinity of the type locality. Figures 11 and 12 show an interesting series from Saratoga Beach (east-central Vancouver Island) that is plainly different from the appearance of butterflies from the type locality (southern Vancouver Island). Figures 7 and 8 show the types of *insulanus* and *amica* side by side to control for the vagaries of photography and to allow easy comparison of the differences and similarities.

It is clear from this brief review that there are numerous and conflicting interpretations regarding *Aricia saepiolus* in northwestern North America. It is equally clear that there is insufficient information presented in the literature to allow an unambiguous assessment of which interpretation is most defensible and congruent with reality in the field. There is no clarity as to where *saepiolus* grades into *insulanus* and *amica* or even if they do. There is no clarity as to where *kodiak* grades into *amica*. The literature also presents differing descriptions of the appearance of the taxa under discussion. We do not elaborate on that here since it is more appropriate to include in a future taxonomic review.

**Figure 7.** Dorsal view of *insulanus* (top) and *amica* (bottom) types. Photo: N. Kondla.

**Figure 8.** Ventral view of *insulanus* (top) and *amica* (bottom) types. Photo: N. Kondla

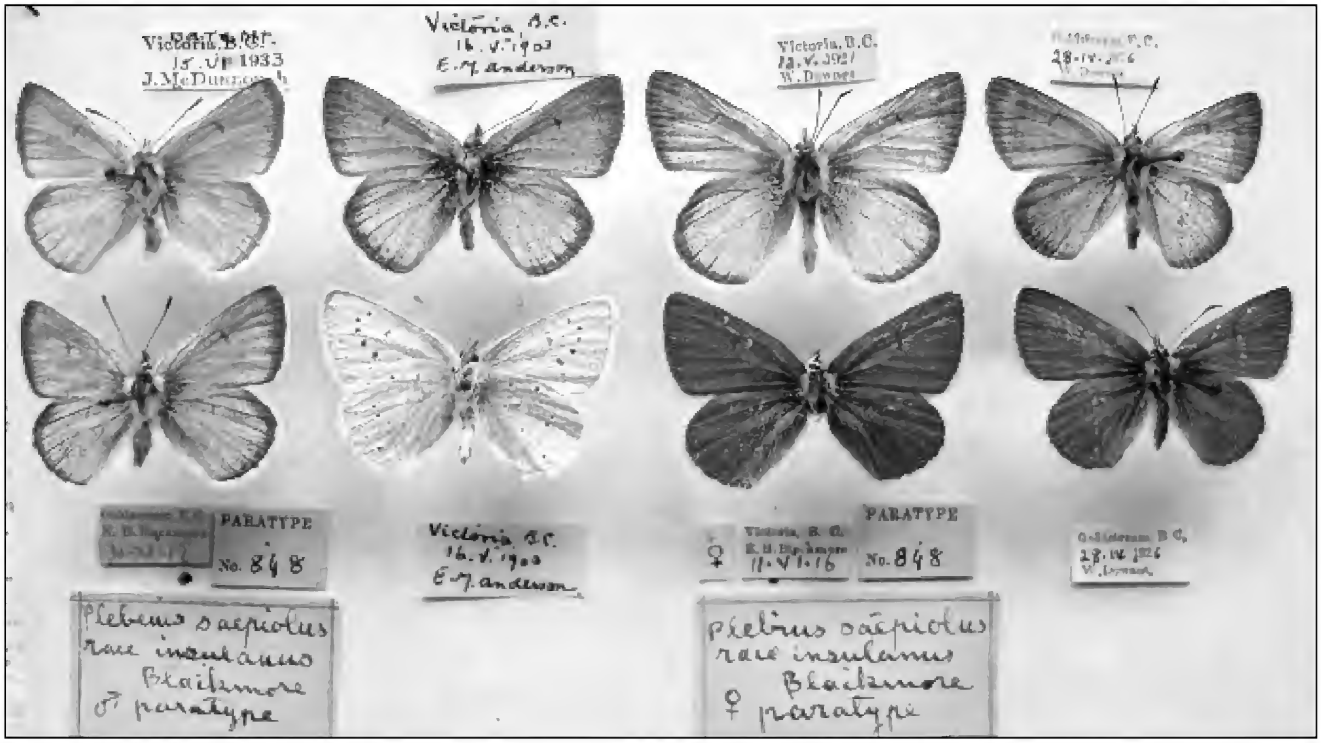



**Figure 9.** *Aricia saepiolus insulanus* specimens from the type locality. Photo: C. Guppy

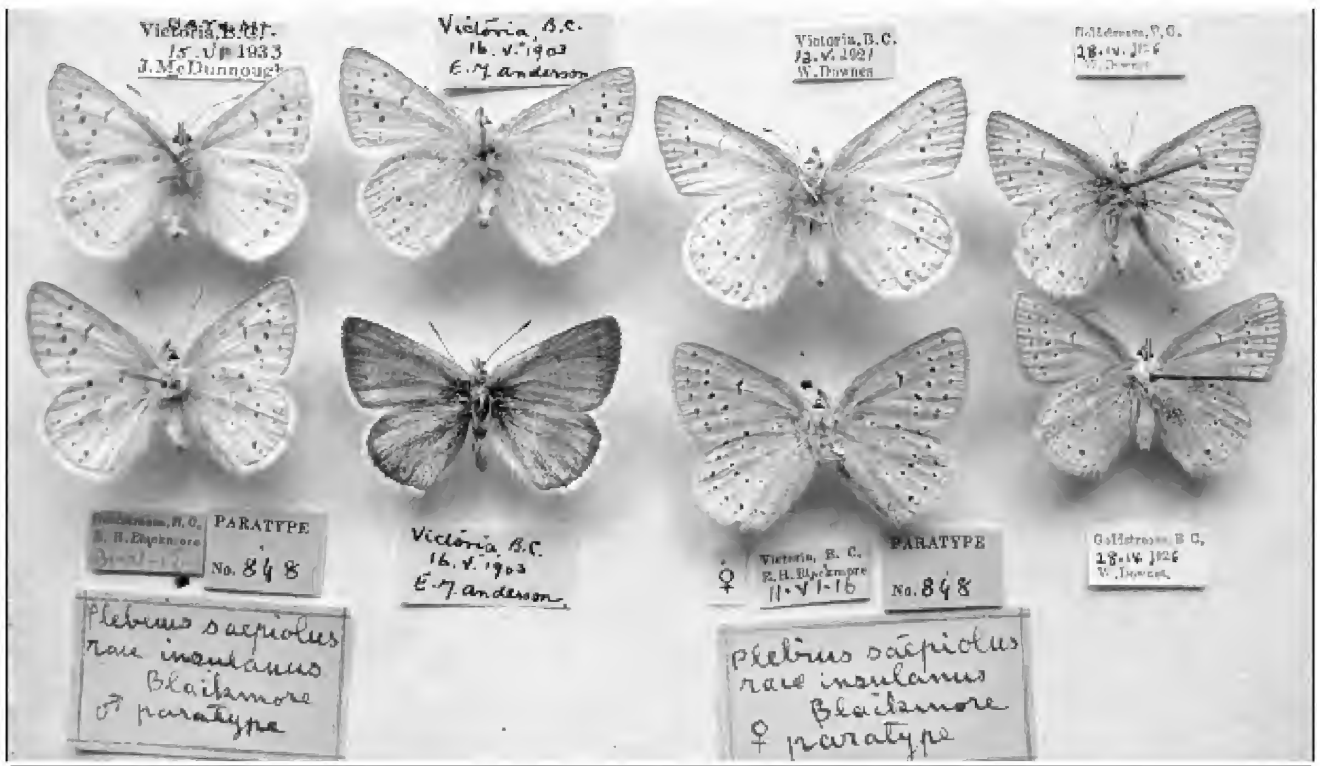



**Figure 10.** *Aricia saepiolus insulanus* specimens from the type locality. Photo: C. Guppy

**Figure 11.** Additional *insulanus* specimens. More than one collection date on individual specimen labels, otherwise all labels are identical to the example shown. Photo: C. Guppy

**Figure 12.** Additional *insulanus* specimens. Same specimens and same data as figure 11 above.

## ACKNOWLEDGMENTS

We thank Dr. J. Don Lafontaine for providing access to the CNC. We also thank Dr. Zsolt Bálint and Dr. Kurt Johnson for reviewing a draft of this paper.

## LITERATURE CITED

AUSTIN, G.T. 1998. Notes on *Plebejus saepiolus* (Boisduval) (Lepidoptera: Lycaeninae: Polyomatinae) in Nevada, with description of a new subspecies. Pp. 819-824 in Emmel, T.C. (ed.). 1998. Systematics of Western North American Butterflies. Gainesville, FL: Mariposa Press. 878 pp.

BALINT, Z. AND K. JOHNSON. 1997. Reformation of the *Polyommatus* section with a taxonomic and biogeographic overview. Neue Entomologische Nachrichten 40:1-68.

BALINT, Z., C.S. GUPPY, N.G. KONDLA, K. JOHNSON, AND C.J. DURDEN. 2001. *Plebeius* Kluk 1780, or *Plebejus* Kluk, 1802? Folia entomologica hungarica 62: 117–184.

BIRD, C.D., G.J. HILCHIE, N.G. KONDLA, E.M. PIKE, AND F.A.H. SPERLING. 1995. Alberta Butterflies. The Provincial Museum of Alberta. 349 pp.

BIRD, C.D. AND C.D. FERRIS. 1979. Type locality of *Epidemia dorcas florus* (Lepidoptera: Lycaenidae). Canadian Entomologist 111:637-639.

BLACKMORE, E.H. 1920. The Lycaenidae of British Columbia. Proceedings of the Entomological Society of British Columbia (1919) 14:5-11.

_____. 1923. Two new races of the genus *Plebeius* Linn. from British Columbia. Canadian Entomologist 55:98-100.

BRIDGES, C.A. 1988. Catalogue of Lycaenidae & Riodinidae (Lepidoptera: Rhopalocera). Urbana, IL: C.A. Bridges. vii + ii + 377 + ii + 115 + ii + 140 + ii + 101 + ii + 37 + ii + 12 + ii + 1 + ii + 10 pp.

BROWN, F.M. 1951. Colorado *Plebeius saepiolus*. Annals of the Entomological Society of America 44:286-292.

_____. 1969. The types of the lycaenid butterflies described by William Henry Edwards. Part II. Lycaenidae. Transactions of the American Entomological Society 95:161-179.

_____. 1970. The types of lycaenid butterflies named by William Henry Edwards Part III. Plebejinae. Transactions of the American Entomological Society 96:353-433.

DOWNEY, J.C. 1975. Genus *Plebejus* Kluk. Pp. 337-350 in Howe, W.H. (editor) The Butterflies of North America. xiii + 833 pp. + 97 pls.

EDWARDS, W.H. 1863. Descriptions of certain species of diurnal lepidoptera found with the limits of the United States and British America. No. 2. Proceedings of the Entomological Society of Philadelphia 2:78-82.

_____. 1870. Descriptions of new species of diurnal Lepidoptera found within the United States. Transactions of the American Entomological Society 3:10-22.

_____. 1884. Descriptions of new species of North American butterflies. Canadian Entomologist 15:209-211.

EMMEL, J.F., T.C. EMMEL AND S.O. MATTOON. 1998. The types of California butterflies named by Jean Alphonse Boisduval: designation of lectotypes and a neotype, and fixation of type localities. Pp. 3-76 in Emmel, T.C. (ed.). 1998. Systematics of Western North American Butterflies. Gainesville, FL: Mariposa Press. 878 pp.

FERRIS, C.D. 1977. Taxonomic revision of the species *dorcas* Kirby and *helloides* Boisduval in the genus *Epidemia* Scudder. Bulletin of the Allyn Museum 45:1-42.

FERRIS, C.D., C.F. DOS PASSOS, J.A. EBNER, AND J.D. LAFONTAINE. 1983. An annotated list of the butterflies (Lepidoptera) of the Yukon Territory, Canada. Canadian Entomologist 115:823-840.

GUPPY, C.S. AND J.H. SHEPARD. 2001. Butterflies of British Columbia. Vancouver: UBC Press. 414 pp

HINCHLIFF, J. 1994. An Atlas of Oregon Butterflies. The Evergreen Aurelians. 176 pp.

_____. 1996. The Distribution of the Butterflies of Washington. The Evergreen Aurelians. 162 pp.

HOLLAND, W.J. 1931. The Butterfly Book. Rev. ed. Garden City, NY: Doubleday. xii + 424 pp. + 77 pls.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE. 1999. International code of zoological nomenclature, fourth edition. London: The International Trust for Zoological Nomenclature. xxix + 306 pp.
KLOTS, A.B. 1936. The interrelationships of the species of the genus *Lycaena* Fabricius (Lepidoptera, Lycaenidae). Bulletin of the Brooklyn entomological Society 31:154-170.
KOHLER, S. 1980. Checklist of Montana butterflies (Rhopalocera). Journal of the Lepidopterists' Society 34:1-19.
KONDLA, N.G. 1999. Pend-d'Oreille Butterfly Survey. Living Landscapes Program report for Royal BC Museum and Columbia Basin Trust. 38 pp. (http://www.livingbasin.com/butterfly/)
LAYBERRY, R. A., P. W. HALL AND J. D. LAFONTAINE. 1998. The Butterflies of Canada. University of Toronto Press. 280.
LEUSSLER, R.A. 1935. Notes on the diurnal lepidoptera of the Canadian arctic collected by Owen Bryant in the summers of 1929 to 1932. II. Bulletin of the Brooklyn Entomological Society 30:42-62.
LLEWELLYN-JONES, J.R.J. 1951. An Annotated Check List of the Macrolepidoptera of British Columbia. Entomological Society of British Columbia, Occasional Paper No. 1. 148 pp.
MILLER, L.D., AND F.M. BROWN. 1981. A catalogue/checklist of the butterflies of America north of Mexico. *Lepid. Soc. Mem.* 2:i–vii, 1–280.
OPLER, P.A. 1975. Subfamily Lycaeninae. Pp. 309-316 in Howe, W.H. (editor) The Butterflies of North America. xiii + 833 pp. + 97 pls.
_____. 1999. A Field Guide to Western Butterflies. Boston: Houghton Mifflin. xiv + 540 pp.
SHEPARD, J.H. 2000. Status of five butterflies and skippers in British Columbia. Government of British Columbia, Wildlife Working Report No. WR-101. 27 pp.
SCOTT, J.A. 1978. The identity of the Rocky Mountain *Lycaena dorcas-helloides* complex. Journal of Research on the Lepidoptera 17:40-50.
_____. 1986. The Butterflies of North America: A Natural History and Field Guide. Stanford, CA: Stanford University Press. 583 pp.
TRAUPMAN, J.C. 1970. The New College Latin and English Dictionary. Bantam Books, Inc. 502 pp.

---

## *The Taxonomic Report*

is a publication of ***The International Lepidoptera Survey (TILS).***
(A Tax Exempt Non-Profit Scientific Organization )

***The Taxonomic Report*** is projected for publication at the rate of 8-10 issues a year. Subscription/ dues for Volume **Four** are $45 US for North America (Can., US., Mex.) and $55 US for overseas subscribers. The subscription year follows the calendar year. All issues are mailed 1st class. At the end of each year, subscribers receive that year's volume on a record-only compact disc (CDR) for permanent archiving and reproduction for personal use (i.e. museums & universities may make as copies as needed in whatever format desired). Non-members may receive individual issues in print for $5 per issue. Individual issues on CDR to non-members are $15 per issue post paid. **Subscriptions** and **individual issue** orders should be made payable to **TILS;** and mailed to: **Treasurer, 126 Wells Road, Goose Creek, SC USA 29445-3413.**

**Articles for publication are sought.** They may deal with any area of taxonomic research on Lepidoptera. Before sending a manuscript, simply write **TILS** at the above address to set up discussion on how to best handle your research for publication.

Catch us on the web at: **www.tils-ttr.org**

Volume 3 15 June 2002 Number 7

The Taxonomic Report
OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# *PTEROURUS APPALACHIENSIS* (PAPILIONIDAE: PAPILIONINAE), A NEW SWALLOWTAIL BUTTERFLY FROM THE APPALACHIAN REGION OF THE UNITED STATES

HARRY PAVULAAN[1]
494 Fillmore Street, Herndon, VA 20170

AND

DAVID M. WRIGHT
124 Heartwood Drive, Lansdale, PA. 19446

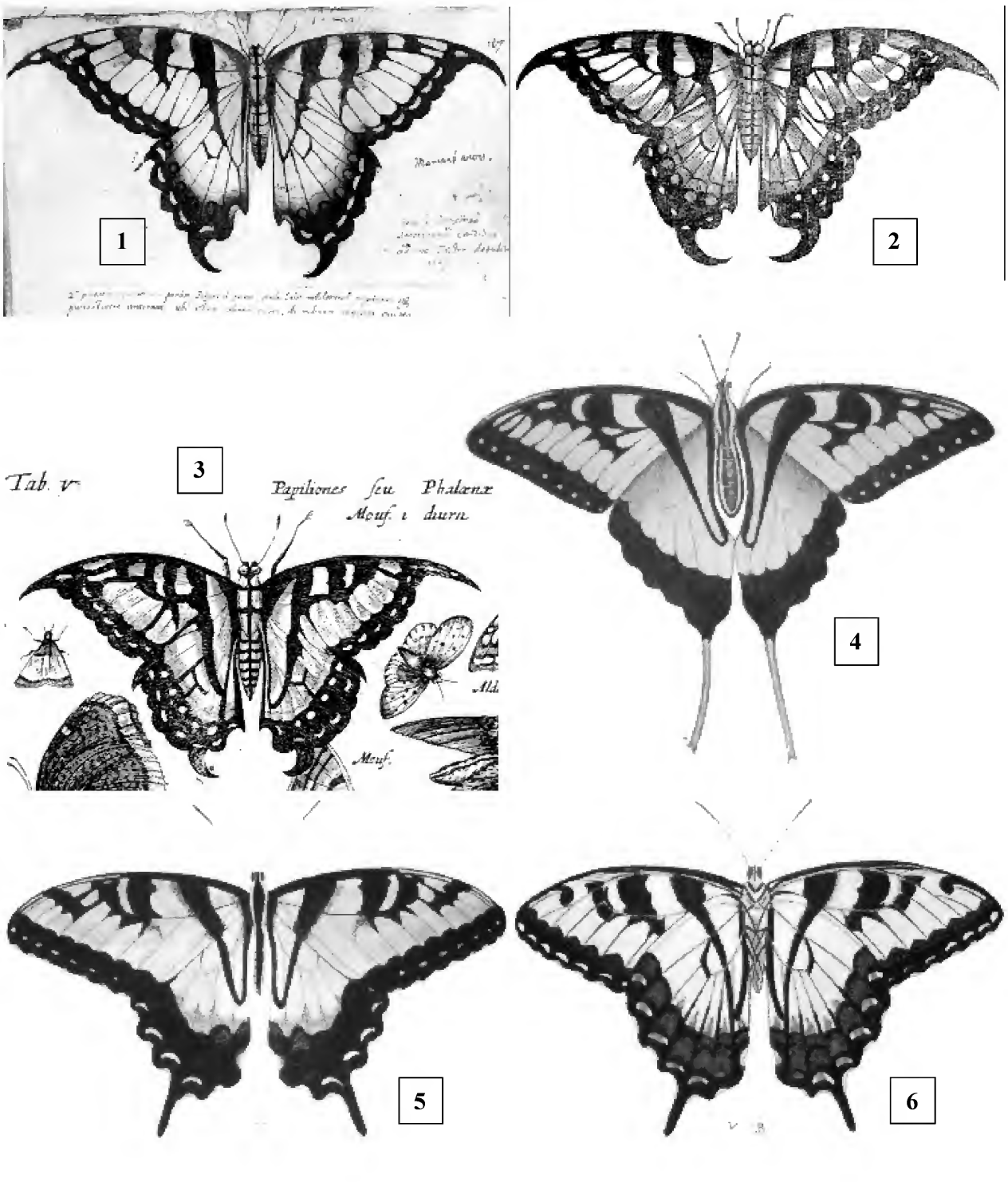
**ABSTRACT**: A new univoltine species of Tiger Swallowtail, *Pterourus appalachiensis*, is described from the southern Appalachian Mountain region of the eastern United States. This distinct swallowtail has remained unrecognized by lepidopterists since the description of its sympatric congener *Pterourus glaucus* (Linnaeus) in 1758. Historical accounts of Tiger Swallowtails from this region pertain specifically to *glaucus* and cannot be attributed to this new species. Morphology, voltinism, phenology, distribution, and behavioral traits indicate species level status of *appalachiensis*. Although *appalachiensis* shares several phenotypic characters with the recently elevated species *canadensis* (Rothschild & Jordan), preliminary mitochondrial DNA analysis indicates that *appalachiensis* is more closely related to *glaucus*. Additional work is needed to identify the natural hosts and evolutionary origins of this fascinating species.

**Additional key words:** Cryptic species, sympatry, species complex.

## REVIEW OF *PTEROURUS GLAUCUS* (LINNAEUS)

The insect commonly known for over 150 years as the Tiger Swallowtail (Miller, 1992) and more recently as the Eastern Tiger Swallowtail (NABA, 1995) has been the subject of intensive investigation in recent years regarding its ecology, genetics, and systematics (Scriber et al., 1995; Scriber, 1996). It was the first butterfly depicted by an artist from the New World. John White, while serving as the expedition leader of Sir Walter Raleigh's third sortie to America ("Virginia" = Roanoke Is., North Carolina), rendered the famous first painting in 1587 which was reproduced in Holland (1931, Pl. 77) (Fig. 1). Despite some exaggerations through artistic license, White otherwise provided accurate detail. The specimen appears to be a male. Among marginalia appended to the original painting is the name "Mamankanois", that is believed to be an equivalent to the Native American Indian name for "butterfly". The painting fell into the hands of Thomas Moffett of London, who directed the making of a woodcut facsimile and its eventual publication in 1634 (p. 98) (Fig. 2). Moffett's figure was copied by Jonstonus in 1657 (Pl. 5) (Fig. 3). The butterfly was described again by Merret (1666) and Petiver (1699), but not figured. Petiver formerly called it "*Papilio Caudatus, luteus, maximus, Virginianus*" and informally referred to it as "Moffet's great yellow

[1] Research Staff member, The International Lepidoptera Survey, 126 Wells Road, Goose Creek , South Carolina 29445




**Figures 1 - 6:** Earliest artistic renditions of *Pterourus glaucus glaucus*. **Fig. 1.** Mamankanois from White, 1587. **Fig. 2.** Moffett's 1634 rendition of Mamankanois. **Fig. 3.** Jonstonus' 1657 copy of Moffett's cut. **Fig. 4.** *Papilio caudatus maximus, Carolinianus* in Catesby, 1736. **Fig. 5.** Dorsal, *Papilio alcidamas*, Cramer, 1775. **Fig. 6.** Ventral, *Papilio alcidamas*, Cramer, 1775.

and black Virginia Butterfly". He also cited the works of Moffett, Jonstonus and Merret. The next depiction (Pl. 83) was by Catesby in his The Natural History of Carolina, Florida and the Bahama Islands, Vol. 2 (1736) (Fig. 4). Catesby called it "*Papilio caudatus maximus, Carolinianus*" and cited Petiver's work. These pre-Linnean names have no standing in The Code, however illustrations and descriptions published in this period may be used by authors erecting Latin names in 1758 and afterward (Article 3.2) (ICZN 1999).

The next descriptions came from Linnaeus (1758), whose Systema Naturae ($10^{th}$ ed.) marked the official beginning of zoological nomenclature. Linnaeus first described *Papilio glaucus* (p. 460) from a dark female form. The location was described as "*Habitat in* America." No type specimen was designated and it is believed that none existed. In the same publication, Linnaeus described *Papilio antilochus* (p. 463). He cited the previous works of Petiver and Catesby, and in so doing referred to a male specimen. The location was given as "*Habitat in* America *Septentrionalis*." Similarly, no type specimen was designated, and it is believed that none existed. Linnaeus (1771) later described *Papilio turnus* from the yellow form of the female and the location was described as "*Habitat in* America". No figure or type was provided. Cramer (1775) described *Papilio alcidamas* (Pl. 38) from a male specimen, and gave the location as "Jamaica, but also can be found from New York to Carolina.". The plate depicts a typical summer form *glaucus* male (Figs. 5 & 6). No type specimen is known. Rothschild and Jordan (1906) restricted the type locality to "New York, Carolina".

## DISCOVERY OF AN UNUSUAL SWALLOWTAIL

During the interval 1985 to 2001, while conducting research in various sites of the southern Appalachian Mountains, yearly emergences of an unusual Tiger Swallowtail were consistently noted. The annual appearance of this butterfly was interpolated in the staggered emergence of what was considered to be one species *Pterourus glaucus*. Traditionally, offset spring flights of an individual species in the mountain region are attributed to stratified climatic conditions. At higher elevations average colder temperatures directly affect the emergence dates of butterflies, where the first individuals appear later than those at lower elevations. In time, however, it became evident to us that climatic conditions could not account for significant differences between low and high altitude populations. The contrasting phenotypes and differences in voltinism between Piedmont and Appalachian populations were reminiscent of sibling species. We theorized that two taxa were likely involved, i.e. standard *glaucus* and a new species. Privately, we choose a temporary moniker for the latter ("giant *canadensis*") because it was quite large and immediately recognizable by its *canadensis*-like yellow submarginal band on the ventral forewing. Furthermore, it had a single brood and lacked a black female form. Careful subsequent sampling allowed us to establish a primary southern Appalachian distribution for this new taxon.

The principal question was did this unusual swallowtail represent an unrecognized population of *Pterourus canadensis* (Rothschild & Jordan) in the southern Appalachians. Allen (1997) included *P. canadensis* in the West Virginia fauna based on phenotypic similarity of mountainous West Virginia populations to *canadensis* populations from areas much further north (Figs. 7 & 8). The primary distinguishing feature of *canadensis* is the strongly developed yellow submarginal band on the ventral forewing. In *glaucus* this band becomes a row of yellow lunules interrupted by black. On June 10, 2001, we sampled and measured several *Pterourus* swallowtails on the summit of Spruce Knob in Randolph Co., WV (4861 ft., Canadian Zone). One segregate of individuals (n=8) was immediately recognizable as *canadensis* by diminutive size (FW costal length 43-48 mm) and a strongly developed submarginal band. This is the only location where we have found *canadensis* in West Virginia, though Allen lists it from five counties. Several attempts to find it at Dolly Sods Natural Area in Tucker Co., WV (Canadian Zone) were unsuccessful. Also flying with standard *canadensis* at Spruce Knob were (n=18) much larger individuals

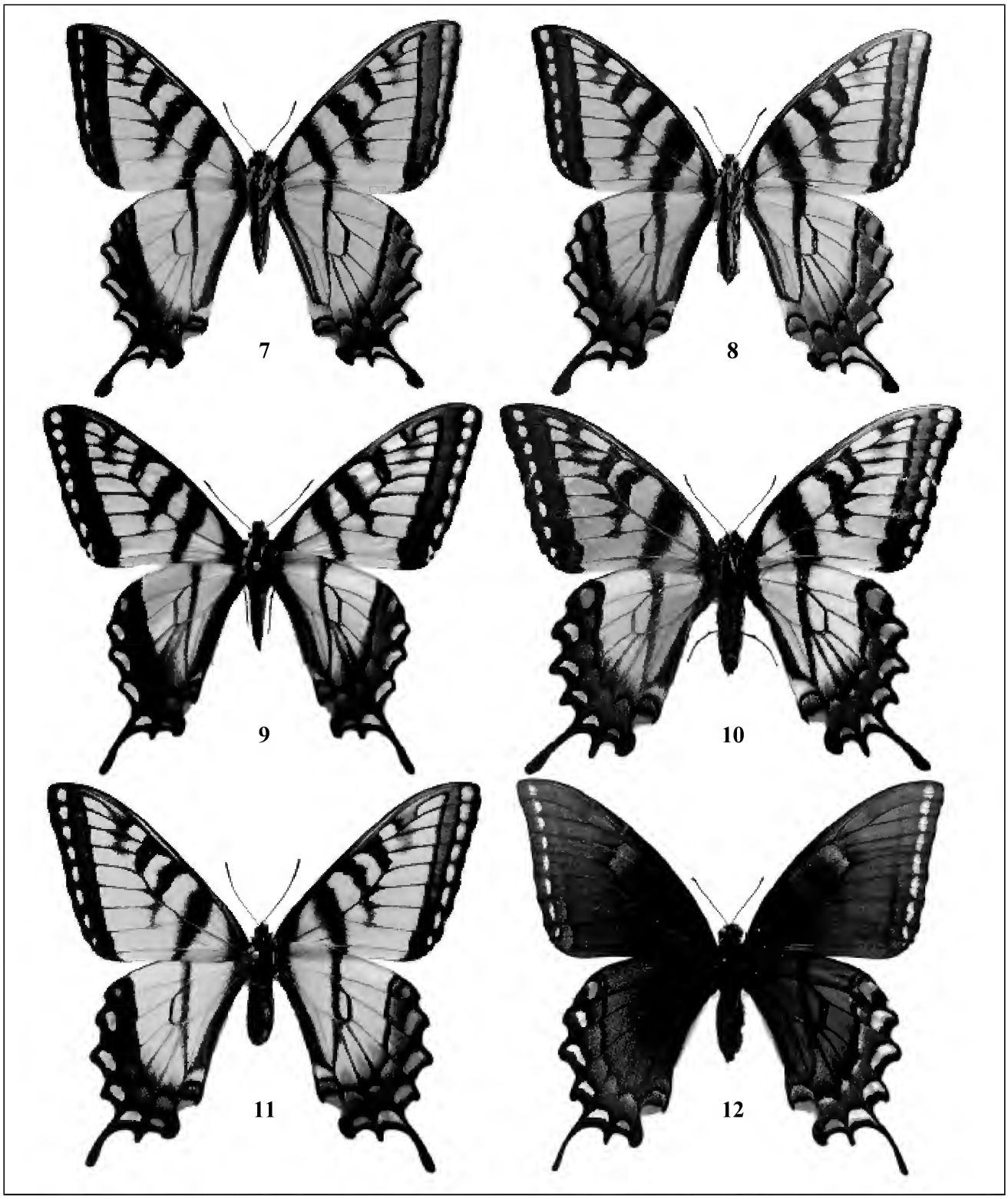
(51-65 mm) of the "giant *canadensis*" phenotype observed elsewhere in the southern Appalachians. With two size segregates clearly present in West Virginia and only the larger phenotype occurring further south in the mountains, we felt it was unlikely that "giant *canadensis*" actually was *canadensis*.

For a time we also entertained the possibility that "giant *canadensis*" represented a hybrid phenotype between low altitude *P. glaucus* and undiscovered populations of *P. canadensis* at higher elevations. Allen (1997) reported that hybridization between *glaucus* and *canadensis* probably occurred in West Virginia and that *canadensis* ranged further south in a hybrid zone through Virginia to western North Carolina. However, an exhaustive search of the mountains of western North Carolina and eastern Tennessee, the Blue Ridge of Virginia, and Dolly Sods Wilderness of West Virginia proved unsuccessful in finding the small *canadensis* phenotype. We also observed that the spring brood of *glaucus* was noticeably absent at higher elevations. Thus in the absence of one parent species or both, hybrids would not be possible. Since the new taxon occurred in such dominant numbers over such broad mountainous regions, we were convinced it was not the product of ongoing hybridization.

It is important to call attention to a confounding situation at low and mid elevations in the Appalachians. Small *canadensis*-like variants of *glaucus* (Fig. 9) occur there regularly in the early spring. These variants often possess strongly developed yellow submarginal bands on the ventral forewing, making them difficult to distinguish from *canadensis* on the basis of that character alone. In some, the black margin of the inner hindwing is also broad, however, this is usually narrower in these variants and aligns with descriptions of this trait in *glaucus*. Virtually all females associated with these early spring, yellow-banded males are readily identified as *glaucus* (Fig. 10), because they have considerable blue on the dorsal hindwing. Also approximately 50% of the early spring females are the black form *glaucus* (Linnaeus) (Fig. 12) in our study area in northern Virginia. Offspring of these early spring *canadensis*-like variants, obtained from ovipositions in captivity on both *Prunus serotina* and *Liriodendron tulipifera*, yield typical summer form *glaucus* adults. Routinely, the early spring populations of *glaucus* (Fig. 11) on the coastal plain and outer Piedmont fail to generate strong *canadensis*-like traits.

The yellow submarginal band on the ventral forewing is a consistent feature of several North American *Pterourus* swallowtails including *P. canadensis* in the north; *P. rutulus* (Lucas), *P. eurymedon* (Lucas) and *P. multicaudatus* (W. F. Kirby) in the west; and *P. alexiares* (Hopffer) in Mexico. *Glaucus* is the exception among the Tiger Swallowtails in having the submarginal band replaced by a row of yellow crescents. We scanned several eastern collections for yellow banded specimens from the Appalachian Mountains in western North Carolina to south-central Pennsylvania and found additional males & females with this character which had been previously labeled "*Papilio glaucus*". All of these specimens were collected within the hypothetical flight period (May-June). The females bore a striking resemblance to *P. canadensis* on the ventral forewings, but departed significantly from *canadensis* on the dorsum. Taken all together, our observations lead us to conclude that we were seeing an unrecognized species. A unique feature of the new taxon is its considerable size, which is in stark contrast to what one would expect in a spring swallowtail in the mountain region.

The most extensive historical coverage of Tiger Swallowtails from this region is found in Clark & Clark (1951). These authors devoted 20 pages to phenotypic variation within *glaucus*, not only in Virginia but also throughout the entire species range, which included at-the-time subspecies *canadensis*. Having carefully read and reread this work, we cannot find clear reference to a unique Appalachian Mountain phenotype. The authors described an early spring phenotype ("late March or early April") from northern Virginia as being comparable to *canadensis* and even to Alaskan *P. canadensis arcticus* (Skinner). Their description is attributable to the early spring *canadensis*-like variant of *glaucus* (Fig. 9) which we found primarily in the Blue Ridge region. Clark & Clark (1951) also described a late-spring phenotype which emerged "ten days or two weeks after the first appearance" of the early spring form. They considered this to be normal *glaucus*, though somewhat intermediate between spring and summer forms. It contained both black and yellow female forms. Their spring form intergraded through an "unbroken series" to "the typical




**Figures 7-12:** *P. canadensis* and early spring *P. glaucus* (all split dorsal/ventral aspects). **Fig. 7.** ♂ *P. canadensis*: no date, Miners Bay, Ontario, Canada (leg. unknown). **Fig. 8.** ♀ *P. canadensis*: same data as 7. **Fig. 9.** ♂ *P. glaucus*: 4 May 2001, Buck Creek, Clay Co., North Carolina (leg. Gatrelle). **Fig. 10.** ♀ *P. glaucus*: 27 April 1999, Blue Mountain, nr. Linden, Warren Co., Virginia. **Fig. 11.** ♂ *P. glaucus*: 23 April 1993, Germantown, Montgomery Co., Maryland. **Fig. 12.** ♀ *P. glaucus*: 7 April 2002, same data as 10. All leg. Pavulaan except Figs. 7-9. All are actual size. Photos: Joe Mueller.

[summer] form" which appeared shortly after the end of the spring flight; occasionally the two broods overlapped. Our observations of *glaucus* on the Piedmont and in the lower mountain elevations parallel those of the Clarks, which is consistent with a bimodal spring emergence pattern (early spring & mid spring). Clark & Clark (1951) also discussed *glaucus* in other text sections of their Virginia monograph, including a curious reference to "northern 1-brooded forms still persist[ing] in the mountains" (p. 7) and to "[some] pupae…remaining dormant until the following spring" (p. 123). Our interpretation is that they did not recognize these points as referable to a different but fairly cryptic species.

## DESIGNATION OF NEOTYPES

We contend that name-bearing types serve to stabilize taxonomic nomenclature and are compelled to designate neotypes for the four names previously published for the species *Pterourus glaucus* (Linnaeus) in the eastern United States. These names are *Papilio glaucus* Linnaeus 1758, *Papilio antilochus* Linnaeus 1758, *Papilio turnus* Linnaeus 1771, and *Papilio alcidamas* Cramer 1775. By erecting name-bearing types, the nomenclature relating to *Pterourus glaucus* is fixed and clarified. This action will help to distinguish *glaucus* from the new species being described below for which there is no available name.

*Papilio glaucus* Linnaeus 1758. Systema Naturae. 10th ed. Vol.1 Stockholm, 824 pp.

**Original description**: (p. 460) Glaucus. 9. P. E. alis subcaudatis nebulosis concoloribus: primoribus macula flava; posticus macula ani fulva. M. L. U. *Habitat in* America. Alae Posticus *Linea transversa fusca bifida; ceteratum Troilo similis*. [Wings dark, cloudy & tailed. Yellow spots on forewings. Hindwings with reddish spot in anal region. Found in America. Wing surfaces with dark indistinct forked transverse veins, otherwise similar to *troilus*.]

**Neotype**: A typical black female specimen of the summer brood (Fig. 19) is hereby designated as the neotype of *Papilio glaucus* Linnaeus 1758. It is currently deposited in the Museum of the Hemispheres, Goose Creek, South Carolina, and bears the following labels: A large label which reads: *Pterourus glaucus* female / Summer black form / September 10, 2000 / Sandbridge / Virginia Beach, VA. A small red hand-written label which reads: NEOTYPE / *Papilio glaucus* Linnaeus 1758 / designated by H. Pavulaan & D. Wright. This specimen was collected from an area near to the John White lead settlement on Roanoke Island, NC, and fixes the name-bearing type to a coastal plain population. This population presently contacts neither *P. canadensis* nor *P. appalachiensis*. The type locality is also outside the range of subspecies *P. glaucus maynardi* (Gauthier, 1984).

*Papilio antilochus* Linnaeus 1758. Systema Naturae. 10th ed. Vol.1 Stockholm, 824 pp.

**Original description**: (p. 463) Antilochus. 28. P. E. alis caudatis concoloribus flavis: fasciis margineque nigris, caudis albis longitudine alae. *Pet. Mus*. 50. N. 505. Papilio caudatis maximus, striis umbrique nigris. *Catesb. Carol*. 2. T. 83 *Habitat in* America *Septentrionalis*. [Wings yellow & tailed. Black bands and margin. Tail edged longitudinally with white. Petiver's Musei Petiverani, etc. (page) 50. No. 505. Large tailed butterfly with black stripes. Catesby's Natural History of Carolina, Florida and the Bahama Islands. Vol. 2, pl. 83. Found in North America.]

**Neotype**: A typical yellow male specimen of the summer brood (Fig. 17) is hereby designated the neotype of *Papilio antilochus* Linnaeus 1758. It is currently deposited in the Museum of the Hemispheres, Goose Creek, South Carolina, and bears the following labels: A large label which reads: *Pterourus glaucus* male / Summer form / July 17, 1988 / Corapeake / Gates Co., NC. A small

red hand-written label which reads: NEOTYPE / *Papilio antilochus* Linnaeus 1758 / designated by H. Pavulaan & D. Wright. This specimen was collected from a coastal area near to the John White lead settlement on Roanoke Island, NC, and represents a corresponding male to the *Papilio glaucus* neotype.

*Papilio turnus* Linnaeus 1771. Mantissa Plantarum. 2nd ed. Stockholm, 587 pp.

**Original description**: (p. 536) Turnus PAPILIO E. A. alis caudatis concoloribus flavis: primoribus fasciis quinque dimidiatis posticeque nigris. *Habitat in* America. *D. Fabricius. Corpus* 2: dae magnitudinus, facie P. Machoanis. *Thorax* limeis flavis. *Alae primores* concolores, flavae, fascii, 5 nigris ad margineum. Extetiorem: harum prima in ipsa basi; fecunda excurrens peralam. Posticam; margo posticus late niger lunulis 8 geminatus flavis. ____ *posticae* repundae, caudatae, subconcolores, flavae, versus postica nigrae. *Fascia* 2: da primorum excurrens versus angulum ani. Lunulae marginis postici, 6 lutae (subtus nagis fulvae) praeter totidem. Lineares marginales. Canda lanceolata nigra. [*Papilio turnus*. Wings yellow and tailed. Forewings with five black bands and hindwings with (about) half as many. Found in America. D.(?) Fabricius. Body (abdomen) twice the size, same appearance as *P. machaon.* Thorax with yellow lines. Forewings uniformly yellow with five black bands and exterior margin; First band at the base of wing, others fanning out to outer margin. Wide black border with eight small lunule-like yellow eyespots. Hindwings curved backward, tailed, nearly all yellow, turning black near edge. Bands on forewing twice the size as those on hindwing, tapering toward anal or posterior portion of wing. Six golden yellow lunules near margins of hindwings (underneath more reddish) in addition to just as many tiny marginal lines, separated by small black distinct projections.]

**Neotype**: A typical yellow female specimen of the summer brood (Fig. 20) is hereby designated as the neotype of *Papilio turnus* Linnaeus 1771. It is currently deposited in the Museum of the Hemispheres, Goose Creek, South Carolina, and bears the following labels: A large label which reads: *Pterourus glaucus* female / Summer yellow form / September 10, 2000 / Sandbridge / Virginia Beach, VA. A small red hand-written label which reads: NEOTYPE / *Papilio turnus* Linnaeus 1771 / designated by H. Pavulaan & D. Wright. This specimen was collected at the same location as the *Papilio glaucus* neotype.

*Papilio alcidamas* Cramer 1775. De Uitlandsche Kappelen, etc. Vol. 1. Amsterdam, 156 pp.

**Original Description**: (p. 62) PLAAT XXXVIII. Fig. A. B. *Alcidamas*. Deze Pagie of Grieksche Ridder Kapel (Pap. Eq. Achivi) gelykt eenigermaate naar de zoogenaamde Konings-Pagie (*Podalirius* Sp. 36. Linn.) die Niet allen in Europa, maar ook in de West-Indien zig onthoud. Deze komt von Jamaika, en valt ook in Nieuw-Jork en Carolina. [Plate 38. Fig. A. B. *Alcidamas*. This species of tailed butterfly with Greek name, which resembles a closely related species (*podalirius* Linn.) that is found in Europe, can be found in West Indies. This one comes from Jamaica, but also can be found from New York to Carolina.]

**Neotype**: A yellow male specimen of the summer brood, which closely resembles Cramer's plate (Fig. 18), is hereby designated the neotype of *Papilio alcidamas* Cramer 1775. It is currently deposited in the Museum of the Hemispheres, Goose Creek, South Carolina, and bears the following labels: A large label which reads: *Pterourus glaucus* male / Summer form / September 10, 2000 / Sandbridge / Virginia Beach, VA. A small red hand-written label which reads: NEOTYPE / *Papilio alcidamas* Cramer 1775 / designated by H. Pavulaan & D. Wright. This specimen was collected at the same location as the *Papilio glaucus* neotype.

## *Pterourus appalachiensis* Pavulaan and Wright, new species

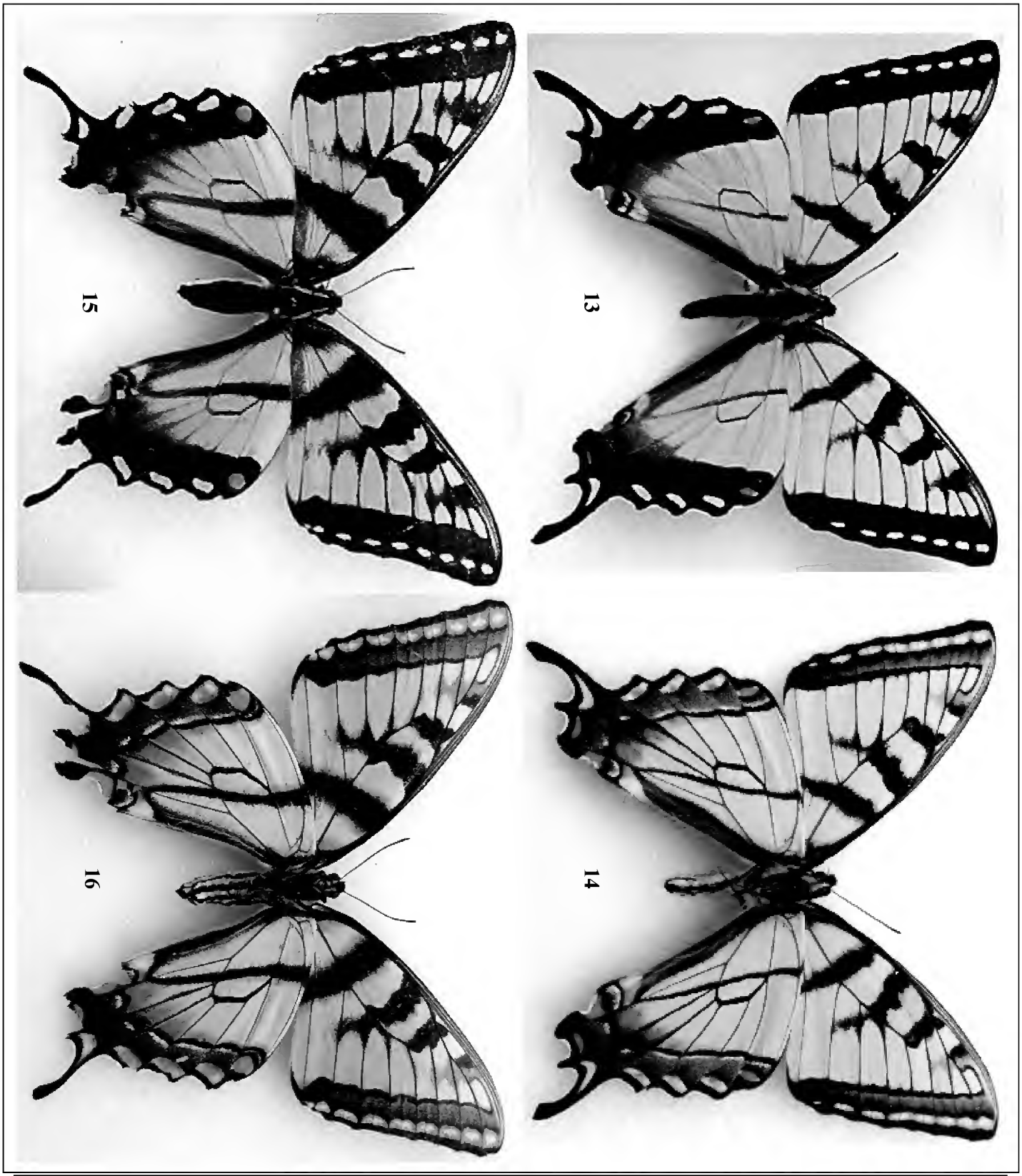
**Description**. In general, similar to widely sympatric *P. glaucus* and locally sympatric *P. canadensis* (in West Virginia). Size comparable to summer brood of *glaucus*, but larger than variable spring brood of *glaucus* and considerably larger than *canadensis*. Male phenotype most similar to *glaucus* males. Female phenotype most similar to *glaucus* females, but with more contrasting features than males. Both sexes also share morphological features with allopatric *P. rutulus* and *P. alexiares*.

**MALE**: FW = 50-62 mm. (n = 66). Holotype (Figs. 13 & 14) FW is 60 mm. **Dorsum**: Ground color yellow. Forewing with broad black margin, occupying 1/5 of wing area from outer margin through subterminal area. Fringe edged with yellow scaling at the ends of the cells between terminal veins. Fringe black at terminus of veins. Black margin contains a row of 8 submarginal yellow lunules from cell R3 to cell Cu2, forming a straight line broken by the interposed veins. Lowest lunule at tornus in cell Cu2 often faded, appearing only as small spot and sometimes absent. In some individuals (<5%) there is a faint subterminal band of yellow scales superimposed on the black margin, weakly-developed at apical portion of the forewing and rarely extending along the entire length of the forewing (<1%). Four large black stripes, nearly parallel to body and perpendicular to costal margin, cross the forewing: the first (submedian) is most prominent and extends the entire length from the costal margin to the inner (anal) margin, crossing the base of vein Cu2 where it meets the discal cell; the second (inner median) extends inward from the costal margin crossing the discal cell and the base of cell M3, then fading across cell Cu1, accompanied by a thickening of black scaling at the base of veins M3 and Cu1; the third (outer median) extends inward from the costal margin along the upper and middle discocellular veins to an abrupt end at vein M2; the fourth (postmedian) extends inward from the costal margin to vein M1, paralleling the outer wing margin and generally fading (partially-developed) in cells R4 and R5. Part of the outer portion of the fourth stripe, toward the costal half of cell R3, curves outward and connects with the broad black margin. This gives the appearance of a subapical vein segment halfway between veins R3 and R4. The space between this false vein and vein R3 contains yellow ground color, lending to the false vein appearance. The wing veins are clearly defined by black scaling, being more prominent near the apex. The base of the forewing is black, curving outward and merging with the costal margin. The inner half of the costal margin is black and contains a streak of grayish-yellow clouding. The outer half of the costal margin generally consists of black veins R1, R2 and R3, with intermediate stripes of yellow ground color between veins.

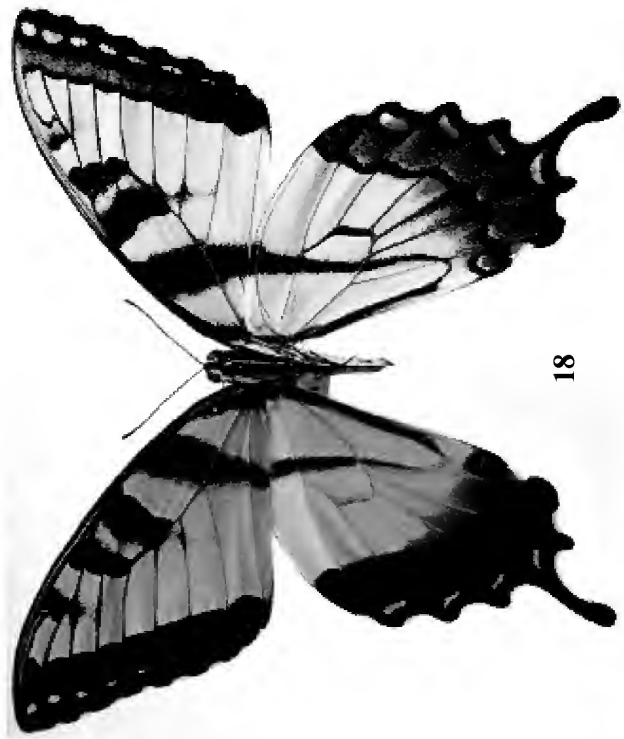
The dorsum of the male forewing resembles *P. glaucus*, but differs mainly in that the black stripes and margin are slightly narrower and the shape of the forewing is slightly more angular in appearance. In most males, the wing appears to have a straighter outer margin. In *glaucus*, especially the summer form, the wing is more rounded in appearance. Within the range of *appalachiensis*, males are considerably larger (50-62 mm) than *glaucus* males of the spring flight (34-53 mm) and are slightly larger than the later summer *glaucus* males (45-58 mm).

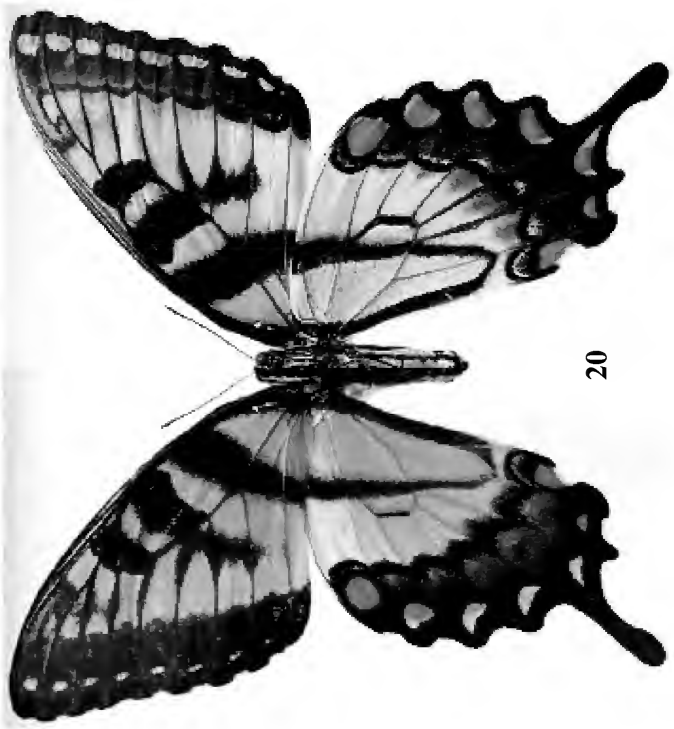
Hindwing with a broad black margin, occupying the outer 1/4 of the wing area; narrower and sharply-defined toward the costal margin. The inner edge of this margin more diffuse and clouded with yellow scaling toward anal angle, most prominent in cells M3 and Cu1. The outer fringe of wing is scalloped. Tail at the terminus of vein M3. Vein Cu1 terminates in a short tail-like stub and vein Cu2 terminates in a large, rounded lobe. Fringe edged with yellow scaling at ends of cells except at vein terminals. Inner edge of the tail lined with a yellow fringe about 2/3 length. Broad black marginal area with row of 6 elongated submarginal lunules. First lunule in cell Sc+R1 smallish, rounded, and deep orange. Lunules in cells RS, M1 and M2 yellow and nearly rectangular in shape. Lunule in cell M3 is a yellow curved crescent extending somewhat into the base of the tail at vein M3. Lunule in cell Cu1 orange and often reduced to a narrow streak. Within broad black margin is a series of faded blue crescents, most developed in cell Cu1 and usually much faded, almost absent in cell M3. Cell Cu2 with the following characters: Anal angle with large orange crescent, edged with wide yellow fringe. Proximal to orange crescent is black area containing a well-developed, narrow blue crescent. Further proximal is a crescent-shaped area of yellow ground color. The remainder of the cell nearly filled with solid black and covered with long light pile (hairs) giving its surface a gray appearance. This black edge (often referred to as black anal band) occupies most of the width of cell Cu2 and extends cephalad across the wing base to the costal margin. A narrow, straight black stripe extends across the hindwing from near the anal angle to a point on the costal margin, marking the junction of inner third and outer two-thirds of the wing. This stripe often aligns with the first (submedian) stripe of the forewing in the resting position. The wing veins of the outer portion of the discal cell are outlined by black scales that form a black arch, which connects at both ends to the outer portion of the straight black stripe.

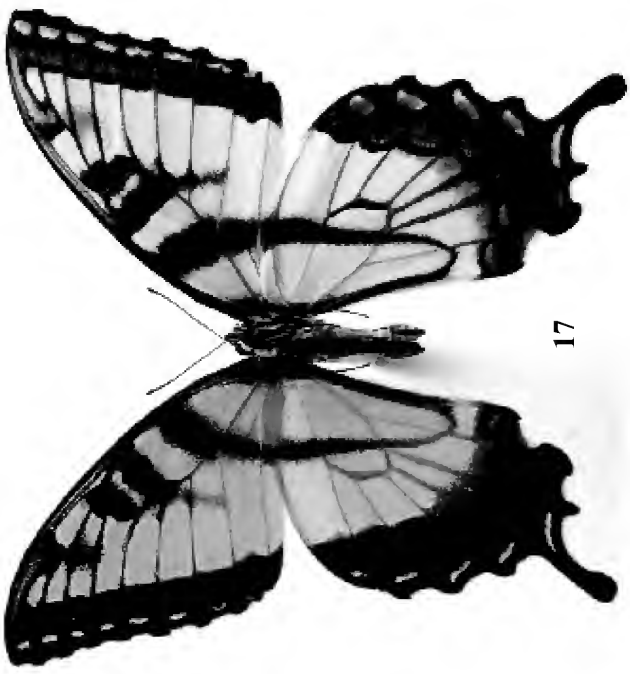
In many aspects, the dorsum of the male hindwing resembles *P. glaucus*. However, the hindwing is noticeably more elongate, narrower and triangular in shape. In *appalachiensis*, the costal margin forms a more squarish angle to the outer margin, whereas in *glaucus* the costal margin arches back and forms a more rounded edge to the outer margin. This difference

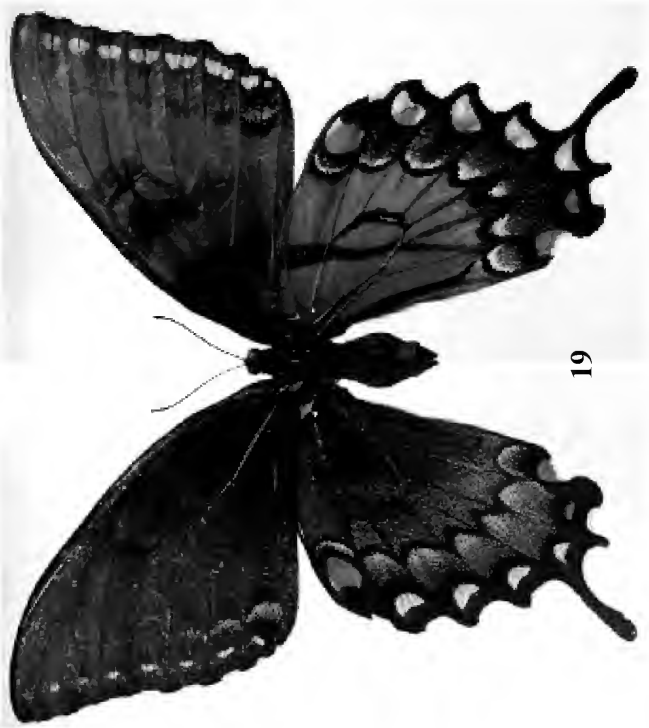



**Figures 13 - 16:** *Pterourus appalachiensis* types. **Figs. 13 & 14.** Holotype ♂ *Pterourus appalachiensis*: 10 May 2001, Buck Creek (3200'), Clay Co., North Carolina (leg. Gatrelle). **Figs. 15 & 16.** Paratype (allotype) ♀ *Pterourus appalachiensis*: 29 May 2001, trail to Scaly Mountain (4300'), Macon County, North Carolina (leg. R. Gatrelle). Specimens are actual size. Photos: Joe Mueller.




**Figures 17 – 20:** Neotypes (all split dorsal/ventral aspects). **Fig. 17**. Neotype ♂: *Papilio antilochus* Linnaeus 1758 (data in text). **Fig. 18.** Neotype ♂: *Papilio alcidamas* Cramer 1775 (data in text). **Fig. 19.** Neotype ♀: *Papilio glaucus* Linnaeus 1758 (data in text). **Fig. 20.** Neotype ♀: *Papilio turnus* Linnaeus 1771 (data in text). Specimens are actual size. Photos by Joe

is more pronounced between *appalachiensis* and summer brood *glaucus*, as well as the larger individuals of spring brood *glaucus*. The scallops of the hindwing margin are more angular and squarish in *appalachiensis*, while those in *glaucus* are more rounded and arched. The tail is narrower in *appalachiensis*, while in *glaucus* it is thicker and has a more "clubbed" appearance. The yellow submarginal lunules are more rectangular in *appalachiensis*; in *glaucus* these lunules are generally more rounded in appearance, often forming arching crescents.

**Venter:** Overall pattern repeats that of the dorsal surface with a few modifications. Ventral ground color is light, pale yellow. On forewing, the broad black margin and three inner black stripes generally of the same size and extent as dorsal surface. Fringe as in the dorsum. Distinct yellow submarginal band as in *P. canadensis.* This band is unbroken from cell R3 at the apex to cell M3. In cells Cu1 and Cu2, band broken by interposed veins forming two yellow lunules. The lowest lunule at the tornus (cell Cu2) reduced and generally broken into two small spots within cell. Lowest of these spots smallest, occasionally absent. Proximal to submarginal yellow band is parallel black band with prominent yellow "clouding". Yellow clouding strongly developed from the apical portion of forewing to cell Cu1. Of the four black stripes which cross forewing, only the fourth (outer) stripe departs significantly from the dorsum. On the venter, this stripe primarily occupies only cell R3. The outer portion of cell R3, toward costal half, curves outward and connects with the broad black margin, giving the appearance of a false subapical vein segment halfway between veins R3 and R4. Space between this false vein and vein R3 contains grayish-yellow clouding which connects to the yellow-clouded band. Wing veins clearly defined by black scaling, being more prominent near the apex. Base of forewing black, curving outward and merging with costal margin. Inner half of costal margin black with streak of grayish-yellow clouding. Outer half of costal margin consists of black veins R1, R2 and R3 with intermediate yellow stripes between veins.

The venter of male forewing resembles *P. glaucus*, but differs mainly in having yellow submarginal band and slightly narrower black stripes and margin. Yellow submarginal band in summer form *glaucus* replaced by row of yellow oval-shaped spots. The spring form of *glaucus* is polytypic and many spring individuals, especially males (Fig. 9), may possess yellow submarginal band to varying degrees. Smallest individuals in first *glaucus* emergence in April often possess a strongly-developed band and take on the appearance of *P. canadensis*.

Hindwing with broad black margin. Fringe edged with yellow as on dorsum. Broad black marginal area with row of 6 elongated submarginal lunules. First lunule in cell Sc+R1 smallish, rounded, yellow with orange central area. Lunules in cells RS, M1 and M2 are yellow, centered with orange, and nearly rectangular in shape. These rectangular lunules are minimally arched along concave portion of scalloped wing edge. (In *glaucus*, these lunules are generally more rounded in appearance, often forming regular arched crescents.) As on dorsum, lunule in cell M3 is a yellow curved crescent extending into base of tail at vein M3. Lunule in cell Cu1 orange and often reduced to a narrow streak. Inner portion of broad black margin dusted with grayish-blue scales extending from cell Sc+R1 to cell Cu1. Cell Cu2 at anal angle with large orange crescent, edged with wide yellow fringe. Proximal to orange crescent is black area containing a well-developed, narrow blue crescent. Further proximal is a crescent-shaped area of pale yellow ground color that may contain varying amounts of orange. The remainder of cell Cu2, as on dorsum, includes wide black anal edge covered with long light pile (hairs). A narrow, straight black stripe extends across the hindwing as on the dorsum and the dark veins of the outer portion of the discal cell connect to this straight black stripe, forming an arch. Wing veins M3 and Cu1, from this straight black stripe to the broad black margin, often outlined with additional black scaling enhancing thickness. Toward the margin, these veins sometimes outlined by grayish clouding. Between these dark enhanced veins, cells M3 and Cu1 contain inward pointing V-shaped areas of orange with bases at edge of black margin. In some individuals, cell M2 contains a reduced amount of this orange scaling.

The male ventral hindwing departs from *P. glaucus* primarily in the more rectangular shape of submarginal lunules.

**FEMALE**: FW = 50-65 mm. (n = 42). Paratype female (allotype) (Figs. 15 & 16) is 63 mm. **Dorsum**: Ground color yellow. Some females with very slight ochreous tint. No black form. Forewing with broad black margin, fringe and submarginal lunules as in the male. Black margin slightly wider than male. Frequently a trace of blue dusting toward the tornus in cell Cu2 which corresponds with band of blue crescents on hindwing. Four large black stripes cross the forewing. These are generally wider than in the male, forming broad black bands. The second (inner marginal) band extends into cell Cu2, while in male it generally only extends into cell Cu1. Wing veins defined by black scaling, being more prominent near the apex. Base of forewing and costal margin as in male.

In most aspects, dorsum of the female forewing resembles *P. glaucus*, but differs mainly in that the shape of the forewing is slightly more angular in appearance. Other minor differences include less ochreous orange than *glaucus* (especially the summer brood), the second (inner median) stripe extends into cell Cu2 (in *glaucus* this stripe usually ends at vein Cu2), and blue crescent at tornus in cell Cu2 of black margin is reduced to a trace of blue dusting. In *glaucus*, this blue

crescent is very prominent, and there are frequently additional small blue crescents within cells Cu1 and M3 of submarginal band.

Hindwing contour, margin, fringe, and tail as in male. Broad black margin with 6 elongated submarginal lunules. The first lunule in cell Sc+R1 smallish, rounded, and deep orange. Lunules in cells RS, M1 and M2 yellow and nearly rectangular in shape. Lunule in cell M3 is a yellow curved crescent extending somewhat into the base of the tail at vein M3. Lunule in cell Cu1 orange and often reduced to a narrow streak. Within the broad black margin is a terminal row of 6 blue crescents, extending from cell Sc+R1 to cell Cu1. Blue crescents in cells M1, M2 and M3 generally equal in size and extent. Blue crescent in cell Cu1 generally larger; crescents in cells RS and Sc+R1 significantly reduced (absent in some individuals). Near anal angle, inner edge of black marginal area diffused and clouded with yellow scaling which is most prominent in cells M2, M3 and Cu1. At anal angle, cell Cu2 with large orange crescent edged with wide yellow fringe. Proximal to orange crescent is black area containing a well-developed, narrow blue crescent. Further proximal is a crescent-shaped area of yellow ground color. Remainder of cell partially occupied with a solid black margin covered with long light pile (hairs). Black anal band of HW inner margin occupies half of width of cell Cu2 (or more) and extends cephalad across the wing base to costal margin. A narrow, straight black stripe extends across the hindwing from near the anal angle to a point on the costal margin, marking the junction of inner third and outer two-thirds of the wing. This stripe broader than in the males and aligned with the first (submedian) stripe of the forewing. Veins of outer discal cell outlined by black scales, forming a black arch.

In some aspects, the dorsum of the female hindwing resembles *P. glaucus*. However, there are noticeable departures between the two taxa. The *appalachiensis* hindwing is more elongate, narrower and triangular-shaped; the costal margin has a more "squarish" angle at the outer margin; the scallops of the wing margin are more angular; the submarginal lunules are more rectangular; the tail is narrower and less "clubbed"; and the anal black band occupies one half (or more) of the width of cell Cu2. In *appalachiensis* the submarginal orange crescent in cell Sc+R1 is smaller than the remainder of the (yellow) submarginal crescents, while in *glaucus* it is noticeably larger than the remaining crescents. A major distinguishing character is the extent of blue markings. In *glaucus*, the terminal blue crescents form a continuous scalloped band spanning the entire wing. These crescents in *appalachiensis* are significantly reduced and form a row of discrete separate crescents; the blue crescents in cells RS and Sc+R1 are often markedly reduced or even absent. Furthermore, in *glaucus* there is generally some blue overscaling in the yellow postmedian area (most evident in black females) which is lacking in *appalachiensis*. Within the range of *appalachiensis*, females are considerably larger (50-65 mm) than *glaucus* females of the spring flight (34-53 mm) and are slightly larger than the later summer *glaucus* females (49-64 mm).

**Venter**: Overall pattern repeats that of the dorsal surface with a few modifications. Ground color light yellow. Forewing broad black margin, fringe, and three inner black stripes generally of the same size and extent as dorsal surface. Black margin contains a yellow submarginal band as in *P. canadensis*. This band is unbroken from cell R3 at the apex to cell M3. In cells Cu1 and Cu2, band broken by interposed veins forming two yellow lunules. Lowest lunule at the tornus (cell Cu2) reduced and generally broken into two small spots within the cell. Lowest smaller and occasionally absent. Yellow subterminal "clouding" parallelling the submarginal yellow band. Fourth (outer) stripe, false subapical vein segment, prominent apical vein scaling, wing base, and costal margin as in male.

In most aspects, the venter of the female forewing resembles *P. glaucus*, but differs mainly in having yellow submarginal band. The submarginal area in summer *glaucus* consists of a row of yellow oval-shaped spots. In polytypic spring *glaucus* brood, a small portion of females possess a yellow band which is not as straight as it is in *appalachiensis* and appears more like a connected row of crescents or scallops.

Hindwing with broad black margin and fringe edged with yellow. Black marginal area with row of 6 elongated submarginal lunules with coloration and shape as in male. Terminal band of grayish-blue clouding in black margin. Cell Cu2 characters as in male, including black anal edge. Narrow black stripe crosses wing as in the male. Dark discal veins form an arch. Veins M3 and Cu1 outlined with additional black scaling enhancing thickness. These veins outlined by grayish clouding toward margin. Cells M3 and Cu1 between these veins contain inward pointing V-shaped areas of orange coloration. In some individuals, cell M2 also with a small amount of this orange scaling.

The female ventral hindwing departs from the general appearance of *P. glaucus* primarily by its more rectangular shaped submarginal lunules and the inner edge contour of the broad black marginal area. In *appalachiensis* this edge generally forms a straight line in cells RS and M1, angling outward in cell Sc+R1 and angling inward in cell M2. In *glaucus* the inner edge of the margin is scalloped inward in each cell.

Note: Small *glaucus* individuals appear in early spring with a yellow submarginal band on the ventral forewing and/or wide black stripe on the HW inner margin (Fig. 9). These variants are usually males and less frequently yellow females (rarely black females). They occur more commonly in the mountain region. This *canadensis*-like form of *glaucus*

should not be confused with *appalachiensis*. A positive identification of *appalachiensis* in any given region is best achieved by finding both sexes as described above. The female phenotype is an especially strong confirmation. Size is also a helpful feature.

**Types and Type Locality.** Holotype male (Figs. 13 & 14): Buck Creek Serpentine Barrens, 3200' elev., Clay County, North Carolina, 10 May 2001, deposited in the Museum of the Hemispheres, Goose Creek, South Carolina. Paratype female (allotype) (Figs. 15 & 16): Scaly Mountain, 4300' elev., Macon County, NC, 29 May 2001, deposited in the Museum of the Hemispheres, Goose Creek, South Carolina. Type location elevation: 3200-3400 ft. 72 additional paratypes, are numbered as follows: (1 – 19: all Buck Creek Serpentine Barrens, 3200-3400' elev., Clay Co., NC): (#1) female, May 14, 2001; (#2-3) females, June 18, 2001; (#4-5) males, May 29, 2001; (#6) male, May 4, 2001; (#7) male, May 29, 2001; (#8) male, June 18, 2001; (#9-15) males, May 29, 2001; (#16), May 18, 2001; (#17) male, May 18, 2001; (#18) male, May 31, 2001; (#19) male, May 18, 2001. All above paratypes currently deposited in the Museum of the Hemispheres, Goose Creek, SC. Numbers 20 – 72 currently retained in the TILS collection of Harry Pavulaan as follows: (#20-23) 4 males, May 10, 2001, Buck Creek Serpentine Barrens, 3200-3400' elev., Clay Co., NC; (#24-26) 3 males, June 1, 1988, Nantahala National Forest, near Bryson City, Swain Co., NC; (#27-37) 10 males, 1 female, June 10, 2000, Blue Mountain, near Linden, Warren Co., VA; (#38-40) 2 males, 1 female, May 28, 2001, Blue Mountain, near Linden, Warren Co., VA; (#41) 1 female, June 8, 2001, Blue Mountain, near Linden, Fauquier Co., VA; (#42-44) 3 males, May 29, 2002, Blue Mountain, near Markham, Fauquier Co., VA; (#45) 1 male, June 10, 2000, Blue Mountain, near Berrys, Clarke Co., VA; (#46) 1 male, May 17, 2002, Blue Mountain, near Berrys, Clarke Co., VA; (#47) 1 female, June 20, 1982, Front Royal, Warren Co., VA; (#48) 1 male, May 19, 1985, near Stanley, Page Co., VA; (#49-50) 1 male, 1 female, May 17, 1986, near Stanley, Page Co., VA; (#51) 1 female, May 31, 1986, near Stanley, Page Co., VA; (#52), 1 male, May 5, 1985, Sugar Grove, Pendleton Co., WV; (#53), 1 male, July 4, 1999, Dolly Sods Wilderness, near Hopeville, Tucker Co., WV; (#54-55) 2 females, June 10, 2001, Spruce Knob, near Riverton, Pendleton Co, WV; (#56-72) 7 males, 10 females, June 5, 2002, Spruce Knob, near Riverton, Pendleton Co, WV.

**Etymology.** *Appalachiensis* is named for the species' fundamental Appalachian Mountain distribution. We propose the common name Appalachian Tiger Swallowtail.

**Immature Stages**: Egg green and globular. Small sample indistinguishable from *glaucus*. A single first stage larva was indistinguishable from *glaucus*. Body black with one distinct white saddle, as opposed to three in *canadensis;* a faint tan mark was observed at the rear saddle position. Gatrelle (pers. com.) obtained a single first stage larva with identical saddle marks. Second stage larva like first stage. Third stage larva with two well-developed saddles in middle and rear sections. Mature green larva indistinguishable from *glaucus*.

**Larval hosts.** One of the greatest challenges to date has been ascertainment of the larval host. The habits of this species have frustrated all our efforts to determine its host(s). The females have proven to be exceedingly elusive, even in locations where males were abundant. It is our opinion that the females remain high in the tree canopy throughout much of the day, and seem to be more frequent along ridge tips or on mountain summits. We routinely observed males patrolling the canopy and we suspected mating probably occurs there. A single observed courtship near the summit of Blue Mountain in northern Virginia (Warren-Fauquier Co. line) took place in the tree canopy. The forest at this site featured a broad variety of tree species dominated by *Quercus* (Oak), *Fraxinus* (Ash), *Acer* (Maple), *Juglans* (Walnut), *Carya* (Hickory), *Magnolia* (Magnolia), *Ostrya* (Hornbeam), *Ulmus* (Elm), and also *Fagus grandifolia* (American Beech), *Liriodendron tulipifera* (Tuliptree), and *Platanus occidentalis* (American Sycamore). Despite hours of field work, we have witnessed no ovipositions along forest edges, roadsides, or utility cuts where *Prunus serotina* (Black Cherry), *Lindera benzoin* (Spicebush), *Hamamelis virginiana* (Witch Hazel), and *Sassafras albidum* (Sassafras) are common. The females on occasion were noted to descend briefly to sunlit lower branches and immediately return to the canopy. Rarely were they observed sunning or nectaring. On the summit of Spruce Knob in Pendleton Co., WV (the only location where we have observed females in abundance), various species of *Betula* (Birch), *Fagus grandifolia* (American Beech) and *Prunus alleghaniensis* (Allegheny Plum) are common. Yet no ovipositional interest was observed. The only potential incident of ovipositional behavior that we have observed occurred on the Blue Ridge in Page Co., VA, where a female was observed flying around a medium-height (15') *Prunus serotina* for several minutes, landing frequently, and curling her abdomen. However, upon close inspection, no eggs were found. Her *appalachiensis* phenotype was confirmed when she briefly rested with wings open. In northern Virginia, *glaucus* females oviposit avidly on many of these trees during both the spring and summer flights. Also *glaucus* females commonly oviposit on trees in the understory, easily allowing for identification of immatures and rearing. Gatrelle (pers. com.) observed ovipositional behavior by a female *appalachiensis* on a species of *Crataegus* (Hawthorn) at the type locality, though no ova were found in a brief and awkward search of this thorny shrub.

Several attempts to obtain ova from captive livestock during the period of 1999 to 2001 failed. Repeated attempts using sleeved females on *Prunus serotina* were wholly unsuccessful. Various types of confinement cages ranging from small portable size (1'x 1'x 2') to large sturdy size (3'x 3' x 5') were also employed. Many small tree species were placed in these cages as planted, potted, or fresh cut specimens. These included wild or in some cases nursery stock of *Prunus serotina*, *Prunus cerasus* (Domestic Cherry), *Fraxinus americana* (White Ash), *Liriodendron tulipifera*, *Betula populifolia* (Gray Birch), *Populus tremuloides* (Quaking Aspen), *Ptelea trifoliata* (Wafer Ash or Hop Tree) and *Syringa vulgaris* (Common Lilac). Again, no ovipositions took place.

More interesting results occurred in 2001. The large cage size was used to confine several females in a multiple host choice experiment with a blooming *Buddleia davidii* (Butterfly Bush) provided as a nectar source. After 15 days, a meager thirteen eggs were discovered. Seven were deposited on the screening near the top of the cage on the sun-exposed side, five were deposited on *Prunus serotina* leaves touching or very near the screening, and one was deposited on a *Buddleia* leaf. We could only conclude from these results that females laid few eggs in captivity and/or the natural host was not present among the offered selections. Most of the first instar larvae emerged and crawled away. None were found on the offered leaves in the cages. Only a single first instar larva was discovered on a cage support. This larva was provided *Prunus serotina* solely. After initially refusing to eat, it reluctantly nibbled on leaves and grew slowly. The resulting pupa went into diapause. It was placed in refrigeration ($4^0$ C) in late summer, then removed to indoor conditions ($22^0$ C) in early March, 2002. After approximately 30 days, a typical female *appalachiensis* emerged. Gatrelle (pers. com.) obtained a single ovum from an *appalachiensis* female (laid on spreading board) which produced a single larva. The first stage larva was offered a choice of *Prunus serotina* and *Liriodendron tulipifera*, but it did not feed and subsequently died.

A control group of *glaucus* females was tested under the same conditions of cages and sleeves over a two-year period. Females of both the yellow form *turnus* (Linnaeus) and the black form *glaucus* (Linnaeus) oviposited abundantly in the cages and sleeves, often within a few hours. In spring of 2000, a black female *glaucus* deposited over 30 eggs on *Liriodendron tulipifera* and *Prunus serotina* in the first day of captivity. In summer of 2000, another confined black form female deposited over 25 eggs on the first day. Females of *appalachiensis* laid no eggs in the same system during this period.

**Flight Period.** *Appalachiensis* is single-brooded and an obligate pupal diapauser. The flight period may be described as being interpolated between the main spring and summer flights of multivoltine *Papilio glaucus* where these taxa co-occur (Phenograms: pg. 17). This situation is most pronounced in the southern Appalachians (Gatrelle, pers. com.). At Blue Mountain, Fauquier Co., VA, the first emergence of *glaucus* precedes *appalachiensis* by approximately three weeks. This flight consists of small to medium-sized *glaucus* early spring phenotypes. A second *glaucus* emergence is observed there at lower elevations at approximately the same time that *appalachiensis* emerges. This emergence occurs primarily in the inner Piedmont and in low valley elevations of the Appalachians; it consists of a highly polymorphic mixture of *glaucus* phenotypes ranging from early spring types to late spring types to intermediate-sized individuals resembling *appalachiensis* (possibly hybrids). At higher elevations (>1800') the flight of *appalachiensis* essentially replaces *glaucus*. To date *appalachiensis* has not been collected or observed in late summer, a finding consistent with the premise that *appalachiensis* is univoltine. The flights of *appalachiensis* and *canadensis* are essentially synchronic where they are sympatric in higher elevations of West Virginia. RECORDED FLIGHT: North Carolina: May 4 (2001) - June 1 (1988); Virginia: April 22 (2001) - June 23 (2000) with mid-late May peak; West Virginia: May 25 (2002) - June 5 (2002); Maryland: June 3 (1990); Pennsylvania: May 19 (2001).

**Habitat.** *Appalachiensis* is a denizen of the densely forested southern Appalachian Mountain chain, being found at all elevations from valley bottoms (Upper Austral Zone) to lofty mountain summits (Canadian Zone). Dense, rich mixed forest is the primary habitat type and we believe it will be found to chiefly utilize hosts in the Transition Zone. *Appalachiensis* replaces *glaucus* as the spring representative of the genus at higher elevations of the southern Appalachians. Very few spring brood specimens of *glaucus* have been documented or observed on the summits. There is reason to believe that *glaucus* may not be able to survive winter temperature minimums characteristic of higher elevations. Limited cold tolerance of overwintering *glaucus* pupae may restrict the species distribution and its ability to acclimatize to high altitude (Kukal et al. 1991). In the Blue Ridge of northern Virginia most *glaucus* individuals in the spring are found in the valleys and the foothills. By late summer, however, *glaucus* is common in flowering meadows along Skyline Drive. Summer individuals on the summit are believed to be descendants of spring migrants and/or summer migrants from lower elevations. (Note in support: In April, 2002, at Blue Mountain in Fauquier Co., VA, during the early spring *glaucus* emergence, virtually no *glaucus* individuals were observed at elevations over 1200 ft. despite large numbers present at lower elevations. During the second *glaucus* emergence (mid-May), very few *glaucus* adults were observed near the 1800 ft. summit despite similarly large numbers present at lower elevations. Finally, on May $29^{th}$, one black form *glaucus* female was observed ovipositing on *Prunus serotina* on the summit, indicating that the spring females do produce some of the summer adults of higher

elevations.) *Appalachiensis* may be prone to periodic irruption. On May 23, 2001, during a major emergence of *appalachiensis* on the Blue Ridge, strays were recorded on the Piedmont as far as 20 miles to the east (Warrenton, VA). Curiously, none were recorded further east on that date or the following days despite an intensive search. In the spring of 2002, strays were not observed.

**Adult Behavior**. Both sexes fly primarily in forested habits. They will cross open breaks in the forest, but seldom stray far from wooded areas. In the first few days of an emergence following a warm spring rain, males congregate at mud puddles and damp earth along watercourses, woodland trails, and road shoulders. Away from human disturbance, they may congregate in very large numbers. The puddle parties are often shared with other species such as *Pterourus troilus, Eurytides marcellus, Everes comyntas, Celastrina neglectamajor, Phyciodes tharos, Erynnis juvenalis* and *Erynnis icelus*. Interestingly, we have rarely observed *Pterourus glaucus* at these puddle parties when *appalachiensis* was present. Roadside congregations can be disturbed by passing automobiles and the presence of road-kill specimens is not uncommon. These road-killed individuals curiously may attract additional individuals. On occasion we have seen flying *appalachiensis* males suddenly dive to inspect road-killed individuals. *Appalachiensis* males also seem to be particularly fond of cow droppings. As the emergence progresses greater numbers appear at higher altitudes. Males are often seen in hurried flight on ridge tops and summits. They can be distinguished from *glaucus* by their more majestic, sailing, looping flight. (Virginia's Skyline Drive on the Blue Ridge is an excellent place to observe *appalachiensis* during flight.)

Females are extremely elusive. They have never been observed at puddle parties. They are usually seen in short glimpses in hurried flight, often 30 ft. high (and higher) in the forest canopy. They prefer to remain in the forest canopy where patrolling males give chase. During courtship encounters, the pair may temporarily descend to the forest floor and then just as quickly return to the forest canopy with the male pursuing the female. Courtship observations have been very difficult to secure while traversing dense rocky habitats at higher elevation. It is usually these same habitats though where female nectaring takes place.

**Adult Nectar Sources.** The adults nectar chiefly on *Rubus allegheniensis* (Blackberry) and *Rosa multiflora* (White Multiflora Rose), both common bramble-like plants which cover sunny patches in the woodland habitat. They have also been observed nectaring on *Kalmia latifolia* (Mountain Laurel), *Prunus serotina* (Black Cherry), *Crataegus crus-galli* (Cockspur Thorn), *Diervilla lonicera* (Bush Honeysuckle), *Rhododendron roseum* (Early Azalea), and *R. nudiflorum* (Pink Azalea). Near the end of the flight period, *Asclepias syriaca* (Common Milkweed) becomes a favorite nectar source.

**Range.** (maps A & B pg. 20). The range at this writing is believed to be primarily the southern Appalachian Mountain region of the eastern United States. The type locality is situated near the southernmost, presently-known location in the Appalachians. Strays have been taken on the Piedmont at locations not far from the mountains. The northern extent is currently undetermined and must be distinguished from the hybrid zone in the northeast between *canadensis* and *glaucus* (Scriber 1990). Additional research is needed to determine the northern limit in Pennsylvania and possibly in New York and New England. Known localities include: **GEORGIA:** RABUN CO.: Sky Valley. **MARYLAND:** ALLEGANY CO.: Flintstone, Green Ridge State Forest; FREDERICK CO.: Catoctin Ridge (Frederick City Municipal Watershed), Gambrill State Park. **NORTH CAROLINA:** CLAY CO.: Buck Creek Serpentine Barrens (Gatrelle, 2001); HAYWOOD CO.: Pisgah National Forest; JACKSON CO.: Pisgah National Forest; MACON CO.: Scaly Mountain, State Hwy 106 west of Highlands; SWAIN CO.: Great Smoky Mountains National Park. **PENNSYLVANIA:** CUMBERLAND CO.: South Mountain (Michaux State Forest); FRANKLIN CO.: Caledonia, South Mountain (Michaux State Forest). **VIRGINIA:** ALBEMARLE CO.: Blue Ridge (Shenandoah National Park); AUGUSTA CO.: Blue Ridge Parkway (George Washington National Forest); CLARKE CO.: Mount Weather (Blue Ridge); FAUQUIER CO.: Blue Mountain (Blue Ridge), Warrenton; FREDERICK CO.: Gore, Great North Mountain (George Washington National Forest); GREENE CO.: Blue Ridge (Shenandoah National Park); LOUDOUN CO.: Mount Weather (Blue Ridge); MADISON CO.: Rapidan State Wildlife Management Area, Blue Ridge (Shenandoah National Park); NELSON CO.: Blue Ridge Parkway (George Washington National Forest); PAGE CO.: Blue Ridge (Shenandoah National Park); RAPPAHANNOCK CO.: Amissville, Blue Ridge (Shenandoah National Park), Sperryville, Washington; ROCKINGHAM CO.: Blue Ridge (Shenandoah National Park), Briery Branch, Massanutten Mountain; WARREN CO.: Blue Mountain (Blue Ridge), Front Royal, Blue Ridge (Shenandoah National Park). **TENNESSEE:** SEVIER CO.: Great Smoky Mountains National Park. **WEST VIRGINIA:** GRANT CO.: Dolly Sods Wilderness Area, Hopeville; GREENBRIER CO.: Kates Mountain; HAMPSHIRE CO.: Capon Bridge. HARDY CO.: Great North Mountain (George Washington National Forest); PENDLETON CO.: Reddish Knob (George Washington National Forest), Spruce Knob; RANDOLPH CO.: Dolly Sods Wilderness Area; TUCKER CO.: Dolly Sods Wilderness Area.

## GENETIC AND EVOLUTIONARY RELATIONSHIPS.

The eastern *Pterourus* species (*glaucus*, *canadensis*, and *appalachiensis*) share an extensive suite of morphological and biological features which is a strong indication of common ancestry. Hagen et al. (1991) recently summarized the evidence demonstrating significant differentiation between *glaucus* and *canadensis*. These two species are distinguished by genetically-controlled differences in adult, larval, and pupal stages. *Canadensis* has a gene for obligate pupal diapause which offers a selective advantage in colder climates where the growing season is shortened and the butterflies are limited to one generation (Hagen & Scriber 1989). On the other hand, diapause in *glaucus* appears to be environmentally determined. A zone of thermal unit accumulations necessary to complete two successful generations (Hagen et al. 1991) delineates the northernmost limit of *glaucus*. Under these control systems, the *glaucus* range cannot expand northward but the *canadensis* range may expand southward. The isotherm that corresponds to the thermal watershed between bi- and univoltine populations coincides with a complex plant ecotone and a narrow zone of butterfly hybridization. This isotherm is sharply defined across the Great Lakes region, but is much less regular and uncertain further east. The isotherm follows a southward course through Pennsylvania and rides the high elevations of the Appalachian Mountains to North Carolina (Scriber & Cage 1995). It has been predicted that the Appalachians provide altitudinal refugia for *canadensis* types and that an inability to complete two generations would select against *glaucus* (Scriber et al. 1996). Many individuals from the mountainous regions of West Virginia are phenotypically *canadensis*; also the highest elevations of the state support very small phenotypes that may be true relict *canadensis*. The southernmost limit of these small *canadensis* types is in West Virginia. They are not found further south in the Appalachians, a situation that is analogous to distributions of other northern butterflies (*Colias interior*, *Lycaena epixanthe*, *Celastrina lucia*, *Speyeria atlantis*).

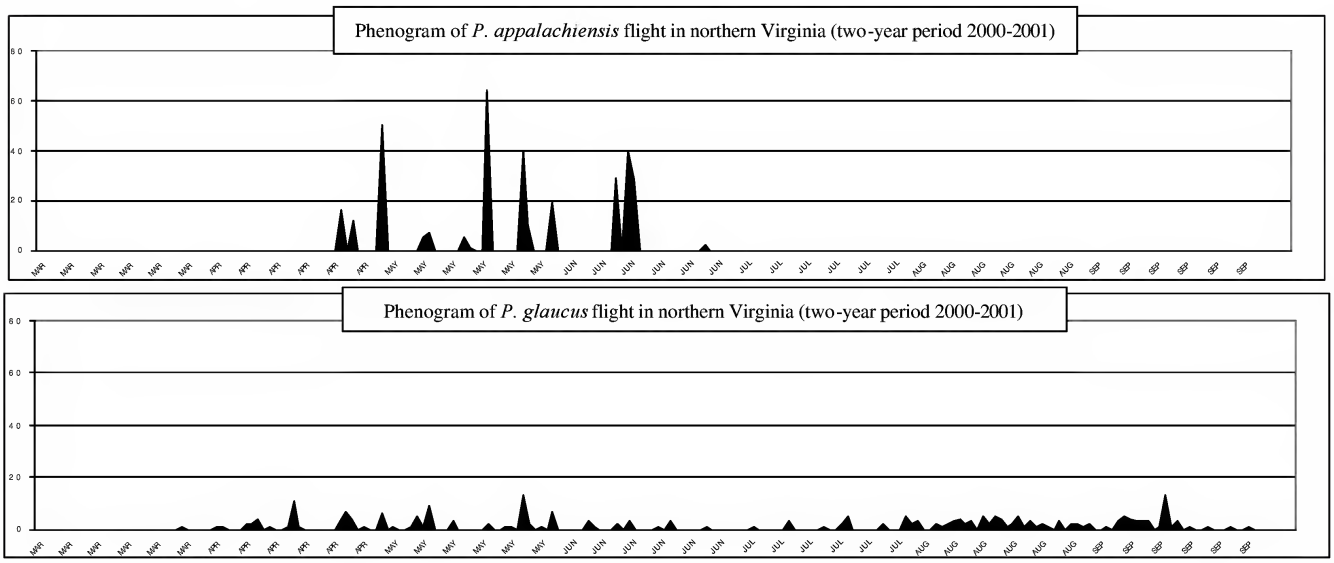
*Pterourus appalachiensis* appears to replace *canadensis* in the Appalachians south of West Virginia. This large univoltine swallowtail combines the phenotypic markings of *canadensis* and the large size of summer *glaucus*. Its origin is unknown. However, because a considerable portion of its mitochondrial DNA is similar to *glaucus*, we conclude that it is neither *P. canadensis* nor a predominately *canadensis* hybrid. The latter have the external appearance of typical *canadensis,* but their larvae can also detoxify tuliptree (Scriber, 1998). Instead we suspect *appalachiensis* evolved principally from a *glaucus* genome initially as a physiologic race or through introgression of unique genes. It is possible that *appalachiensis* independently evolved genes advantageous for life at high elevation or acquired them during past periods of interbreeding. Climatic variation during the Pleistocene could have expanded the range of *canadensis* to contact ancestral *appalachiensis* in the southern Appalachians. The acquisition of an obligate diapause gene (among others) may have accelerated the acclimatization of *appalachiensis* to the southern Appalachian highlands in the post Pleistocene period.

Very little is known about isolating mechanisms between *appalachiensis* and *glaucus* in nature. Their nearly allochronic flights, differing altitude preference, and contrasting behaviors (especially of females) would seem to keep their zone of contact confined to a narrow ecological gradient. To the extent that hybridization occurs, it has not diluted the essence of either taxa. Lastly, we raise the intriguing possibility that *appalachiensis* is older than *glaucus* and is more closely related to a shared common ancestor with *canadensis*. Perhaps *appalachiensis* provided the advantageous genes that spurred *canadensis* radiation in the north.

**Hybridization study.** In a limited breeding study, a reared black form female *P. glaucus* (*ex* larva, 9/10/00, on *Prunus serotina* from Virginia Beach, VA) was crossed with a male *P. appalachiensis* (captured at Blue Mountain, Warren Co., VA, on April 22, 2001) and placed inside a breeding cage with *P. serotina*. This female oviposited readily and produced 24 ova in two days before dying. All ova yielded first instars with a single white saddle mark and a very faint tan rear saddle mark, thus appearing like the two documented *appalachiensis* larvae. Eight died in the first instar stage. An additional six larvae died during development and the remaining ten reached pupal stage. These pupae diapaused and were placed outdoors in a protected location before being taken indoors in late February, 2002. Seven pupae produced large males of intermediate phenotype between *appalachiensis* and *glaucus*. The three largest pupae (females) failed to eclose. The apparent failure to produce eclosed hybridized females parallels our inability to find naturally-occurring intermediate females (esp. black forms) in our study sites and may be indicative of an isolating mechanism at work.

## A NOTE ABOUT THE NORTHERN LIMIT OF *APPALACHIENSIS.*

More work is needed to ascertain the northern limit of *appalachiensis.* Field observations in Rhode Island from 1983 to 2001 recorded a regular sequence of emergences of Tiger Swallowtails throughout the state. The season began with flights of both standard *glaucus* and *canadensis*-like phenotypes in April, which often lasted until early June. No black females were recorded in RI during the spring. A second emergence, consisting of very large *appalachiensis*-like phenotypes emerged during the month of June and flew into early July. Likewise, no black females were recorded in this emergence. During the latter half of July, a second brood of *glaucus* appeared and flew into early September. The latter consisted of a variety of forms, including large ochreous yellow females and occasional black females in years of abundance (M. Schenck, pers. obs.) In 1983, captive females of both spring *glaucus* and *canadensis*-like phenotypes oviposited freely on *Prunus serotina.* The *glaucus* progeny produced typical summer specimens in the same year (second brood). The progeny of *canadensis*-like females went into diapause (pupae desiccated during the following winter). Females of the *appalachiensis*-like phenotype captured in June also oviposited on *P. serotina* and produced diapausing pupae (pupae desiccated during the following winter). The experiment with RI *appalachiensis*-like females was repeated in 1994. Diapausing pupae successfully survived the winter and produced *appalachiensis*-like adults in early July of the following year. We intentionally did not include Rhode Island in the formal range of *appalachiensis* in our paper, and leave open the question of its occurrence in southern New England to future investigation. The issue of a potential hybrid zone of *glaucus* x *canadensis* (and/or *glaucus* x *appalachiensis*) in this region needs clarification.




## ACKNOWLEDGMENTS

We gratefully acknowledge the following people and thank them for their invaluable service: Ronald Gatrelle for providing specimens (including the type specimens) from North Carolina and reviewing the manuscript; Niklas Wahlberg, Department of Zoology, Stockholm University, Sweden, for performing mitochondrial DNA analyses; Felix Sperling, Department of Biological Sciences, University of Alberta, for providing directions to access the databases at NCBI; Eileen Mathias, Information Services Librarian, Ewell Sale Stewart Library, The Academy of Natural Sciences of Philadelphia, Philadelphia, PA, for assistance in researching historical literature; Don Azuma, Entomology Department, The Academy of Natural Sciences of Philadelphia, for access to collections; Jackie & Lee Miller, Allyn Museum of Entomology, Sarasota, FL, for access to collections: Eric Quinter, Entomology Department, American Museum of Natural History, New York, NY, for access to collections; John Rawlins, Section of Invertebrate Zoology, Carnegie Museum, Pittsburgh, PA, for access to collections; Alex Grkovich for sharing collection data; Bob Gardner for sharing western Maryland field notes and corroborating some observations; Tom Allen, West Virginia DNR, Elkins, WV, for stimulating discussions of *Pterourus* swallowtails in his state; Joseph Mueller for photography of specimens.

## LITERATURE CITED


ALLEN, T.J. 1997. The Butterflies of West Virginia and Their Caterpillars. Pittsburgh, PA: University of Pittsburgh Press. xii + 388 pp.

CATERINO, M.S., and F.A.H. SPERLING. 1999. Papilio phylogeny based on mitochondrial cytochrome oxidase I and II genes. Molecular Phylogenetics and Evolution 11(1): 122-137.

CATESBY, M. 1736. The Natural History of Carolina, Florida and the Bahama Islands. Vol.2. Printed by author. London, 100 pp + appendix 20 pp + index.

CLARK, A.H., and L.F. CLARK. 1951. The Butterflies of Virginia. Smithsonian Misc. Collections 116(7): vii + 239 pp.

CRAMER, P. 1775. De Uitlandsche Kappelen Voorkomende in de drie Waereld-Deelen Asia, Africa en America, by een verzameld en beschreeven. Vol. 1. Amsterdam: Baalde, Utrecht, Wild, 156 pp.

GATRELLE, R.R. 2001. Initial Survey of the Butterflies and Skippers in the Vicinity of the Buck Creek Serpentine Barrens, Clay County, North Carolina. The Taxonomic Report 3(5):1-6.

HAGEN, R.H., R.C. LEDERHOUSE, J.L. BOSSART and J.M. SCRIBER. 1991. *Papilio canadensis* and *Papilio glaucus* (Papilionidae) are distinct species. Journal of the Lepidopterists' Society 45(4):245-58.

HAGEN, R.H. and J.M. SCRIBER. 1989. Sex-Linked Diapause, Color, and Allozyme Loci in *Papilio glaucus*: Linkage Analysis and Significance in a Hybrid Zone. Journal of Heredity 80(3):179-185.

HOLLAND, W.J. 1931. The Butterfly Book. Revised Edition. New York: Doubleday, Doran, 424 pp.

ICZN (International Commission on Zoological Nomenclature). 1999. International Code of Zoological Nomenclature. 4th ed. London: The International Trust for Zoology Nomenclature, 306 pp.

JONSTONUS, JOHANNES. 1657. Historiae naturalis de insectis, libri III. De serpentibus et draconibus, libri II ... Amstelodami, Apud I. I, fil. Amsterdam: Schipper.

KUKAL, O., M.P. AYRES, and J.M. SCRIBER. 1991. Cold tolerance of pupae in relation to distribution of swallowtail butterflies. Canadian Journal of Zoology 69: 3028-3037.

LINNAEUS, C. 1758. Systema Naturae. 10th ed. Vol.1 Stockholm, 824 pp.

_____. 1771. Mantissa Plantarum. 2nd ed. Stockholm, 587 pp. (Animalia p. 521-552)

MILLER, J.Y. 1992. The Common Names of North American Butterflies. Washington, D.C.: Smithsonian Press, 177 pp.

MERRET, CHRISTOPHER. 1666. Pinax rerum naturalium britanni carum, continens vegetabilia, animalia, et. fossilia. London: F. and T.Warren.

MOFFETT, THOMAS. 1634. Insectorum sive mimimorum anumalium theatrum: olim ab ab Edoardo Wottono, Conrado Gesnero, Thomaque Pennio inchoatum: tandem Tho. Morfeti Londinatis operasumptibusq: maximis concinnatum, auctum, perfectum: et ad vivum expressis iconibus supra quingentis illustratum. [Edited by Sir Theodore Turquet de Mayerne.] London: Thomas Cotes.

NABA. 1995. The North American Butterfly Association (NABA) Checklist & English Names of North American Butterflies. Morristown, NJ: NABA Special Publication. 43 pp.

PETIVER, JAMES. 1699. Musei Petiverinai centuria [secundadecima] Rariora Naturae continens: viz. Animalia, fossilia, plantas. London: S. Smith and B. Walford.

ROTHSCHILD, W. and K. JORDAN. 1906. A revision of the American papilios. Novitates Zool. 13: 411-744.

SCRIBER, J. MARK. 1990. Interaction of introgression from *Papilio glaucus canadensis* and diapause in producing "spring form" Eastern Tiger Swallowtail butterflies, *P. glaucus* (Lepidoptera: Papilionidae). The Great Lakes Entomologist 23(3): 127-135.

SCRIBER, J.M. 1996. Tiger tales: Natural history of native North American swallowtails. American Entomologist 42(1): 19-32.

_____. 1998. The inheritance of diagnostic larval traits for interspecific hybrids of *Papilio canadensis* and *P. glaucus* (Lepidoptera: Papilionidae). The Great Lakes Entomologist 31(2): 113-123.

SCRIBER, J.M. and S.H. CAGE. 1995. Pollution and global climate change: Plant ecotones, butterfly hybrid zones and changes in biodiversity. (p. 319-344) In J.M. Scriber, Y. Tsubaki & R.C. Lederhouse (eds.). Swallowtail butterflies: Their ecology and evolutionary biology. Gainesville, FL: Scientific Publishers.

SCRIBER, J.M., R.H. HAGEN and R.C. LEDERHOUSE. 1996. Genetics of mimicry in the tiger swallowtail butterflies, *Papilio glaucus* and *P. canadensis* (Lepidoptera: Papilionidae). Evolution 50(1): 222-236.

SCRIBER, J.M., Y. TSUBAKI, and R.C. LEDERHOUSE. (eds.). 1995. Swallowtail butterflies: Their ecology and evolutionary biology. Gainesville, FL: Scientific Publishers, 459 pp.

## APPENDIX

Provided below is the DNA nucleotide base sequence of the mitochondrial gene COI (cytochrome oxidase subunit I) from the *Pterourus appalachiensis* male holotype and female paratype, plus the comparable sequence from a typical male & female *P. glaucus* collected at the *appalachiensis* type locality. A total of 1460 residues of this 1.5 kb gene were aligned for comparison. In the display we have highlighted the two nucleotide positions that were found to vary between these closely-related taxa.

### *Pterourus appalachiensis*

TGAGCAAGAATATTAGGAACTTCTTTAAGTTTATTAATTCGAACTGAATTAGGAACTCCGGTTCTTTAATTGGAGATGCCAAATT
TATAATACTATTGTAACAGCTCATGCTTTTATTATAATTTTTTTTATAGTTATACCAATTATAATTGGAGGATTTGGAAATTGACT
AGTACCTTTAATATTAGGGGCACCTGATATAGCCTTTCCTCGAATAAATAATATAAGATTTTGACTTTTACCCCCTTCTTTAACT
CTTTTAATTTCAAGAATAATTGTTGAAAGTGGAGCTGGAACTGGATGAACTGTTTATCCCCCTCTTCTTCCAATATCGCTCATGG
AAGAAGATCAGTAGATTTAGTTATTTTTTCCCTTCATTTAGCAGGGATTTCTTCAATTTTAGGAGCAATTAATTTTATTACTACAA
TTATTAATATACGAATTAATAATATATCATTTGATCAAATACCTTTATTTGTTTGAGCTGTTGGAATTACAGCTTTATTATTACTT
CTTTCATTACCTGTTTTAGCTGGAGCTATTACAATACTATTAACAGATCGAAACTTAAATACATCATTTTTTGATCCTGCAGGAG
GGGGAGATCCAATTTTATATCAACATTTATTTTGATNNNNNNNNNNNNNNNNNTTTATATTTTAATTTTACCTGGATTTGGAA
TAATTTCTCATATTATTTCTCAAGAAAGAGGAAAAAAGGAAACATTTGGATGTTTAGGTATAATTTATGCTATAATAGCAATTG
GATTATTAGGATTTATTGTTTGAGCTCATCATATATTTACAGTAGGAATAGATACAGATACTCGAGCTTATTTTACCTCAGCAAC
AATAATTATTGCAGTTCCTACTGGAATTAAAATTTTTAGATGATTAGCAACTCTTCATGGAACTCAAATTAATTATAGTCCATCA
ATTTTATGAAGTTTAGGATTTGTATTTCTATTTACAGTAGGAGGATTAACTGGAGTAATTTTAGCTAACTCTTCTATTGATGTTAC
CTTACATGATACATATTATGTAGTAGCTCATTTTCATTATGTTTTATCTATAGGAGCTGTATTTGCTATTATAGGAAGATTTATTC
ATTGATACCCATTATTTACCGGTCTTTCTTTAAATCCTTATCTTTTAAAAATTCAATTTTTTACAATATTTTTTGGGGTAAATTTA
ACCTTTTTTTCCCCAACATTTCTTAGGATTAGCTGGAATACCTCGCCGATATTCAGATTATCCTGATAATTTTACCTCATGAAATAT
TATTTCTTCTTTTGGATCTTATATTTCTTTATTGTCATTAATAATAATAATAATTATTTGAGAATCAATAATTAATCAACGAA
TTATTTTATTTTCTCTTAATATACCATCATCTATTGAATGACTTCAAAACTTACCTCCTGCAGAACATTCATATAATGAACTTCCT
ATTTT

### *Pterourus glaucus*

TGAGCAAGAATATTAGGAACTTCTTTAAGTTTATTAATTCGAACTGAATTAGGAACTCCAGGTTCTTTAATTGGAGATACCAAAT
TTATAATACTATTGTAACAGCTCATGCTTTTATTATAATTTTTTTTATAGTTATACCAATTATAATTGGAGGATTTGGAAATTGAC
TAGTACCTTTAATATTAGGGGCACCTGATATAGCCTTTCCTCGAATAAATAATATAAGATTTTGACTTTTACCCCCTTCTTTAACT
CTTTTAATTTCAAGAATAATTGTTGAAAGTGGAGCTGGAACTGGATGAACTGTTTATCCCCCCTTTCTTCCAATATCGCTCATGG
AAGAAGATCAGTAGATTTAGTTATTTTTTCCCTTCATTTAGCAGGGATTTCTTCAATTTTAGGAGCAATTAATTTTATTACTACAA
TTATTAATATACGAATTAATAATATATCATTTGATCAAATACCTTTATTTGTTTGAGCTGTTGGAATTACAGCTTTATTATTACTT
CTTTCATTACCTGTTTTAGCTGGAGCTATTACAATACTATTAACAGATCGAAACTTAAATACATCATTTTTTGATCCTGCAGGAG
GGGGAGATCCAATTTTATATCAACATTTATTTTGATNNNNNNNNNNNNNNNNNTTTATATTTTAATTTTACCTGGATTTGGAA
TAATTTCTCATATTATTTCTCAAGAAAGAGGAAAAAAGGAAACATTTGGATGTTTAGGTATAATTTATGCTATAATAGCAATTG
GATTATTAGGATTTATTGTTTGAGCTCATCATATATTTACAGTAGGAATAGATACAGATACTCGAGCTTATTTTACCTCAGCAAC
AATAATTATTGCAGTTCCTACTGGGATTAAAATTTTTAGATGATTAGCAACTCTTCATGGAACTCAAATTAATTATAGTCCATCA
ATTTTATGAAGTTTAGGATTTGTATTTCTATTTACAGTAGGAGGATTAACTGGAGTAATTTTAGCTAACTCTTCTATTGATGTTAC
CTTACATGATACATATTATGTAGTAGCTCATTTTCATTATGTTTTATCTATAGGAGCTGTATTTGCTATTATAGGAAGATTTATTC
ATTGATACCCATTATTTACCGGTCTTTCTTTAAATCCTTATCTTTTAAAAATTCAATTTTTTACAATATTTTTTGGAGTAAATTTA
ACCTTTTTTTCCCCAACATTTCTTAGGATTAGCTGGAATACCTCGCCGATATTCAGATTATCCTGATAATTTTACCTCATGAAATAT
TATTTCTTCTTTTGGATCTTATATTTCTTTATTGTCATTAATAATAATAATAATAATTATTTGAGAATCAATAATTAATCAACGAA
TTATTTTATTTTCTCTTAATATACCATCATCTATTGAATGACTTCAAAACTTACCTCCTGCAGAACATTCATATAATGAACTTCCT
ATTTT

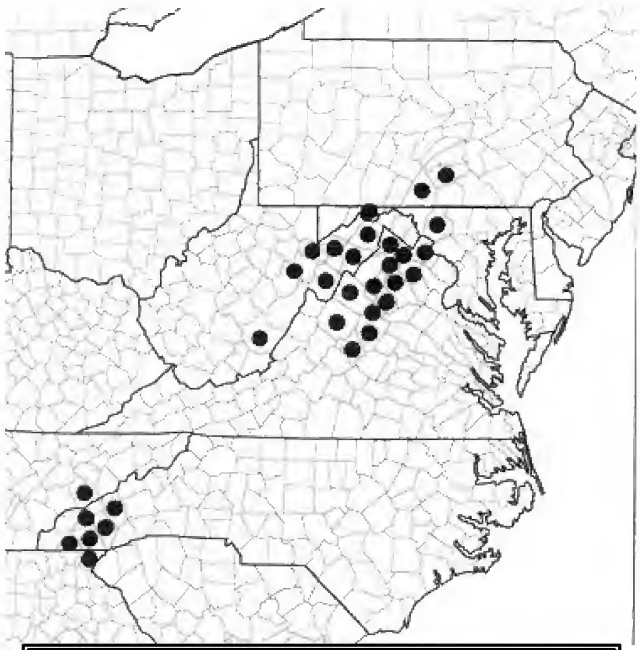
In order to compare *P. appalachiensis* mtDNA with other *Pterourus* swallowtails of the *glaucus* group, COI gene sequences were downloaded from the internet site of the National Center for Biotechnology Information (NCBI) available at http:www.ncbi.nlm.nih.gov/. Gene data were available for *Papilio (Pterourus) glaucus* from Potomac, MD [Accession no. AF044013]; *P. canadensis* from Richford, NY [AF044014]; *P. rutulus* from Orcas Island, WA [AF044015], and *P. multicaudatus* from Black Hills, SD [AF044016]. Collection localities were given in Caterino & Sperling (1999). The *P. glaucus* samples from the Appalachian Mountains and the Piedmont share the same gene sequence, while other taxa diverge from *glaucus* to varying degrees. From this preliminary comparison (Table 1), it can be concluded that *appalachiensis* is much more closely related to *glaucus* than to *canadensis* or any other North American *Pterourus* swallowtail.

**Table 1**

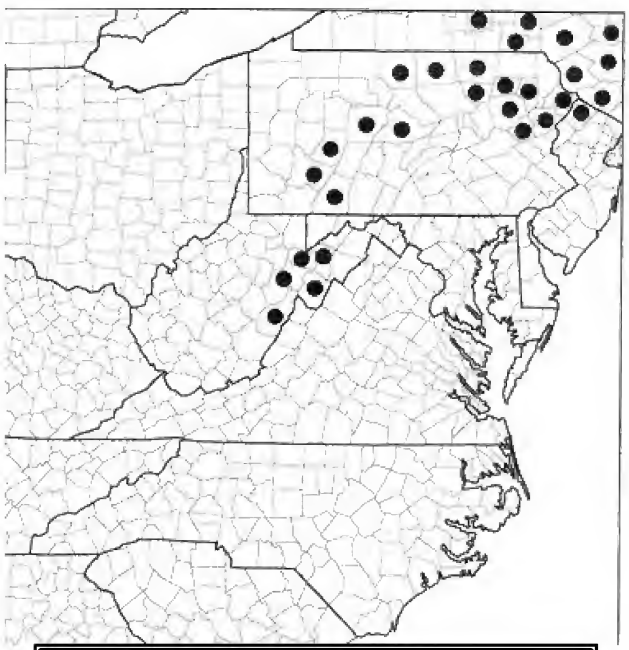
| COI Gene | | No. of nucleotide base differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F |
| *P. glaucus* 1 | A | | 0 | 2 | 24 | 35 | 45 |
| *P. glaucus* 2 | B | 0 | | 2 | 24 | 35 | 45 |
| *P. appalachiensis* | C | 2 | 2 | | 25 | 36 | 45 |
| *P. canadensis* | D | 24 | 24 | 25 | | 27 | 41 |
| *P. rutulus* | E | 35 | 35 | 36 | 27 | | 47 |
| *P. multicaudatus* | F | 45 | 45 | 45 | 41 | 47 | |

1 = North Carolina (Mts.)
2 = Maryland (Piedmont)

Mitochondrial DNA data can only be evaluated in view of maternal lineages. Our limited sampling may have failed to detect considerable intraspecific variation in *appalachiensis.* Small polymorphisms, such as those between *P. appalachiensis* and *glaucus* above, could be interpreted either as a retained ancestral polymorphism or as evidence of recent gene flow through hybridization. Molecular studies of multiple genes, particularly nuclear genes inherited from both parents, may provide a balanced picture of the genetic history of *appalachiensis.* The combination of genetic, morphological, and biological data will help define the limits of this species.



**Map A.** Study area distribution of *P.*



**Map B.** Study area distribution of *P. canadensis.*

**Visit *The International Lepidoptera Survey* on the World Wide Web at: TILS-ttr.org**
**- and -**
**Join the discussion at our list serve on Yahoo!Groups at: TILS-Leps-Talk**

Volume 3 30 November 2002 Number 8

The Taxonomic Report
OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# A REVIEW OF *POANES HOBOMOK* (HESPERIIDAE: HESPERIINAE) WITH THE DESCRIPTION OF A NEW SUBSPECIES FROM THE SOUTHERN APPALACHIANS

RONALD R. GATRELLE [1] [2]
126 Wells Road, Goose Creek, South Carolina 29445-3413

**ABSTRACT.** *Poanes hobomok monofacies* is described from the southern limits of the Appalachian Mountains in western North Carolina, northern Georgia and eastern Tennessee. The type locality is Chestnut Mountain, 3,400', Macon County, North Carolina. This new subspecies is characterized by the similarity of males and females and overall much darker and subdued marking when compared to both *P. h. hobomok* (eastern to mid, northern US & eastern to mid, southern Canada) and *P. h. wetona* (Colorado & New Mexico). The northern and western range of this new taxon and the area of its intergradation with nominate *hobomok* remains to be established, however, specimens from as far south in the Appalachians as West Virginia are nominate *hobomok*. All subspecific descriptions are presented. Syntypes are recognized for *P. hobomok* in the MCZ, Harvard. The type of *wetona* is illustrated for the first time. It is concluded that nominate *hobomok* and *wetona* differ significantly only in females, that *ridingsii* is a doubtful subspecies, and *monofacies* has the most distinct males.

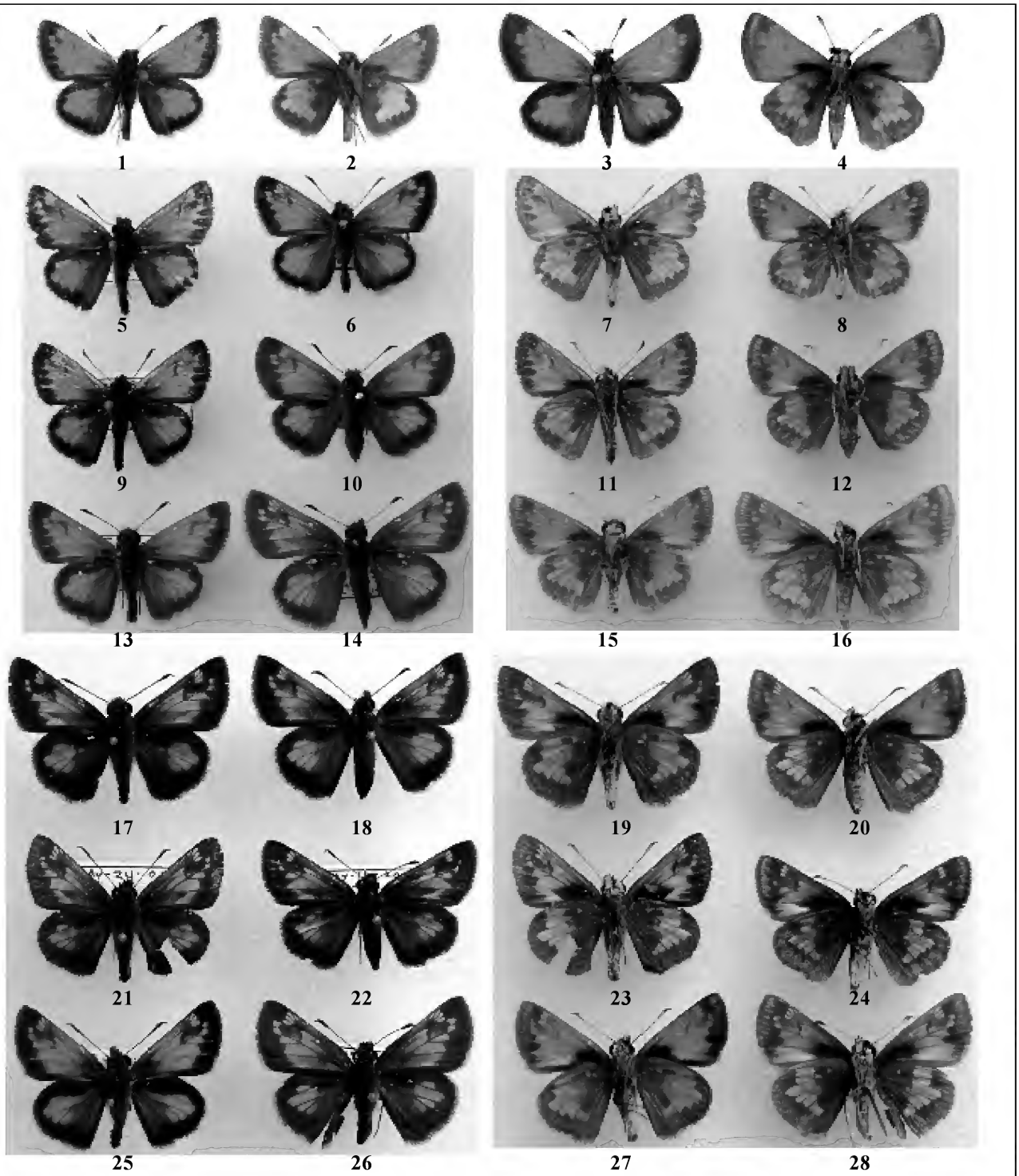
**Additional key words:** form *alfaratta*, melanism.

## Discovery and Overview of a New Subspecies

Since the late 1980s I have made numerous trips to the southern Appalachian Mountains of western North Carolina and northeast Georgia to research the butterflies and skippers of that region. *Poanes hobomok* (Harris) 1862, is local, but not uncommon, in that area. In 1994, I noticed I had incorrectly determined two males as females in the small sample I had collected in this region. This manifested that the sexes were very similar and that both sexes were decidedly darker than individuals I had from the Midwest. I thus began a concerted effort to collect *hobomok* at various locations in that region. By 2002 I had acquired a sufficient sample from a variety of sites which confirmed that this was a unique and hitherto undescribed subspecies of *Poanes hobomok*.

This new subspecies, described herein, has much less fulvous on the dorsal surface of males than the males of the nominate subspecies (typical in New England region). Females of the new subspecies are much less variable than nominotypical females. For example, while the dark female form *pocahontas* (Scudder), 1864 is frequent to common in the New England region, it is apparently infrequent in western North Carolina and northern Georgia. Further, New England and southeastern Canadian *hobomok* females frequently have extensive dorsal fulvous (Fig. 10); this never occurs in females of the new subspecies. Both males and females of the new subspecies have the ventral hind wing yellow patch reduced and within

[1] Staff Researcher, The International Lepidoptera Survey, Goose Creek, South Carolina.
[2] Research Associate, Florida State Collection of Arthropods, Gainesville, Florida.




**Figs. 1-28:** *Poanes hobomok* subspecies. **Figs. 1/2** (D/V), ♂ *P. h. wetona* holotype (data pg. 5). **Figs. 3/4** (D/V), ♀ *P. h. wetona*, Colfax Co., NM., leg. Spomer. **Figs. 5/7** (D/V), ♂ *P. hobomok*, Melrose, MA, 2 June 2002, leg. Grkovich. **Figs. 6/8** (D/V), ♂ *P. hobomok*, Lake Co., MN, 29 July 1967. **Figs. 9/11** (D/V), ♂ *P. hobomok*, Gardner, MA, 8 June 2002, leg. Grkovich. **Figs. 10/12** (D/V),♀ *P. hobomok*, Edmund-ston, NB, CAN, 25 June 1961. **Figs. 13/15** (D/V), ♂ *P. hobomok*, Hardin Co., IA, 2 July 1967. **Figs. 14/16** (D/V), ♀ *P. hobomok* (same data as 13). **Figs. 17/19** (D/V), ♂ *P. h. monofacies* holotype (data pg. 6). **Figs. 18/20** (D/V), ♀ *P. h. monofacies* allotype (data pg. 6). **Figs. 21/23** (D/V), ♂ *P. h. monofacies* paratype, Clay Co., NC, 24 May 2002. **Figs. 22/24** (D/V), ♀ *P. h. monofacies* paratype, Macon Co., NC, Jones Knob, 16 May 2002. **Figs. 25/27** (D/V), lightest ♂ *P. h. monofacies* paratype (data as 22). **Figs. 26/28** (D/V), lightest ♀ *P. h. monofacies* paratype, (data as 22 except, 4 June 1993). 13-28 leg. Gatrelle. All X 1.20 natural size. Dorsal/Ventral. 17,18,21,22 form *alfaratta*.

a darker brown ground color than in nominate *hobomok*. The phenotype of the new subspecies is not indicated to be an ecotype produced by altitude or short photoperiod. So far it has been found to occur as low as 900 feet and as high as 4400 feet and likely has a much wider altitudinal range.

The western subspecies *Poanes hobomok wetona* Scott, 1981 was described from Colorado at 7200 ft. and displays the opposite phenotypic extreme as individuals are heavily fulvous in both males and females (Figs. 1-4). Further, the lightest males and females in the east are found more commonly the further north the species occurs into Canada. The many specimens I have examined in this study indicate that the increase in dorsal fulvous correlates with increased elevation or shorter photoperiods. If this assessment is correct, then the melanistic phenotype of the new subspecies is significant as it occurs in the opposite phenotypic direction, but within the same short day niche, which indicates that this phenotype is a product of genetics and not ecology – not an ecotype. It should be noted that melanistic facies are a common occurrence among many species of Lepidoptera in the southern Appalachian region.

My primary purpose in this paper is to bring the existence of this subspecies to the attention of the scientific and conservation communities. Thus, there are a few questions that remain to be addressed by subsequent research. Foremost of which is the determination of the limits, or extent, of this taxon's range. I have examined a large number of specimens in the course of this study from throughout the range of species *hobomok*. At present, the new subspecies is confirmed only from western North Carolina, Georgia, and eastern Tennessee. It likely extends into northwestern South Carolina, northern Alabama and possibly much further west (Arkansas?).

The few specimens of *P. hobomok* I have seen from West Virginia indicate that it does not occur there but may inhabit the southernmost areas of that state. The blend zone may occupy much of Virginia and north central North Carolina. Although this should not be assumed. For example, no mention of darker males is made in either the Butterflies of West Virginia (Allen, 1997) or Butterflies of Virginia (Clark and Clark, 1951) and both books figure typical *Poanes hobomok hobomok* males. Males with very reduced dorsal fulvous (f. *alfaratta* Holland, 1930) are only know in the new subspecies described herein.

## Examination of Described Taxa

### *Poanes hobomok hobomok*

*Poanes hobomok* was described by Thaddeus W. Harris in 1862 as *Hesperia hobomok*. This was a posthumous publication 6 years after his death (Harris:1795-1856). This was in A TREATISE ON SOME OF THE INSECTS INJURIOUS TO VEGETATION, third edition. (The cover reads: HARRIS'S INSECTS INJURIOUS TO VEGETATION - FLINT.) This was actually the fourth in a series that began with the REPORT ON SOME OF THE INSECTS INJURIOUS TO VEGETATION published by the *Commissioners on the Zoological and Botanical Survey of Massachusetts* in 1841. The next three versions were in 1842, 1852 and 1862. *Hobomok* was not described until this 4th edition – which is as follows.

***Hesperia hobomok*. Hobomok Skipper. (Fig. 137)**

Dark brown above; on each of the wings a large tawny-yellow spot occupying the greater part of the middle, four or five minute spots of the same color near the tips of the fore wings, on which is also a short brownish line at the outer extremity of the central mesh; under side of the fore wings similar to the upper, but paler; hind wings brown beneath, with a yellow spot near the shoulder, and a very broad deep yellow band, which does not attain the inner margin and has a tooth-like projection extending towards the hinder edge. The male has not the usual distinguishing oblique dash on the fore wings, which differ from those of the female only in the greater size of the tawny portion, which extends to the front margin.

Expands from 1 7/20 to 1 4/10 inch.

This skipper comes very near to the Otho of Smith and Abbot (Which is not the same as the Otho of Boisduval), and also approaches closely to a species that is figured in Dr. Boisduval's work under the name Zabulon; but does not sufficiently agree with either of them, and, in the belief that it has not been described before, I have given it the name of one of our celebrated Indian chiefs. It is found in June and July.

No type locality is established in the text. Because earlier editions state that either New England or Massachusetts is the area being surveyed, Massachusetts has historically been considered the type locality. I am not comfortable with this technically as in the 4th volume in which the name *hobomok* is introduced no state or region is mentioned anywhere. I thus here restrict the type locality to Massachusetts.

No type specimens are designated nor are any references given to any. There is a black and white woodcut on the margin, but this was commissioned and added by the editor (Flint) and can not thus be considered the type.

The Harris collection is located at the Museum of Comparative Zoology (MCZ), Harvard University. There are four old specimens in the Harris collection which I believe are actual syntypes used by Harris. Collectively they constitute the type (ICZN Article 73.2). These specimens have very few labels but what labels they do have are quite significant. Three have only a hand written label that says 171. This is a reference to Harris's notebook where he listed his species by number. The only other data is a date on the fourth specimen of – June 15 1839. I have sought to designate one of these as a lectotype but have been unable to secure photographs from the MCZ. There is nothing in the OD text or in Harris's notebook to indicate that these are syntypes. But the one bearing a label of June 15 1839 is compelling evidence of an actual type. If this specimen is in good condition, and especially if typical of Massachusetts' specimens, I recommend it be designated as the lectotype.

The MCZ web site provides information and photos of its types. The site refers to these 4 specimens as Type. The data is given but no photos. I have contacted the Museum to obtain more information and photos of these specimens. I was told that photos were not available. Because another *hobomok* subspecies is being described in the eastern United States, I think it important to have the nominate taxon clearly defined by proper typification and type locality. This should be done as soon as possible. There is always the possibility that one or more of these alleged types may yet prove to just be old specimens that someone else wrote 171 on.

Brown (1975) conducted an in-depth study into the literary history and Code relativity of the posthumous publication of this Harris name. While the information he uncovered is impressive, I disagree with part of his conclusions. I have been assisted greatly in this by David Wright who concurs. The problem is two fold. One issue is that of authorship of the name *hobomok*, the other date of publication. There were three works that appeared about the same time and each had Harris's descriptions in them. I will just mention them here under Brown's paper rather than cite them individually. They are the works of Scudder, Morris and Flint. Brown seemed to think that the name *hobomok* might be attributable to one of these men which is why he saw the date of publication of such importance.

Brown's concern was unwarranted as in all cases the text of the description was clearly attributed to Harris and put forth as his work alone. Since the Morris paper was dated as published in February of 1862 and all that is stated in the Flint volume re date of publication is simply 1862, Brown determined that it was necessary to find the actual month of the Flint edition to assure proper authorship. One can read this all in the Brown paper, so I will just address what I consider Brown's error.

Brown concluded that there were several issuances of the 3rd edition. I do not accept this for two reasons. First, if this were so I think they would have been referred to as different editions. Second, the item Brown assessed the *publication* date by was the date of the Editor's Preface in these books. These are simply the dates each preface was written not the volume published. To me, this is proven by this statement. "The copy in the British Museum (N.H.) library has the Editor's Preface dated 'Boston, December, 1861'. The publication date for this printing is '1862' ". Brown missed the obvious by seeing the publication date as 1861even though 1862 is explicitly stated. The Code requires that when a date of publication is present that that is the date of publication. I don't think we can tell the exact month the 3rd edition was published. But this is a moot point, in my view, as the author is Harris regardless of the month or in which of the three publications his description appeared in 1862 because the text is always attributed to Harris.

### *Poanes hobomok ridingsii*

The number of subspecies recognized depends on how taxonomists assess (or synonymise) these entities. Of the four possible subspecies, *Poanes hobomok ridingsii* F.H. & R.L. Chermock, 1940 is the most controversial. The original description of *ridingsii* is quite odd. By the title and first portions of the text, *ridingsii* is clearly presented as an infrasubspecific form which does not have availability by the rules of the *International Code of Zoological Nomenclature*. However, the authors lastly apply this epithet as a subspecies in the Riding Mountains and types are designated.

Thus, *ridingsii* is introduced as a form but made an available name within the same article! Its range is limited to the Riding Mountains of Manitoba, Canada. The few specimens (6) from Manitoba I have seen do not convince me that this should be considered a subspecies. Someone should examine this in detail. In the mean time, the name *ridingsii* can be utilized as at least a form name in Canada if anyone wishes to do so. Here is the original description

**Poanes hobomok ridingsii** new form

This form has the same relationship to *hobomok* that *suffusa* has to *massasoit*. The upper surface is slightly darker in color than that of *hobomok*. The discal patch on the secondaries below is very heavily overcast by brownish scales. We have a very extensive series of this form from the Riding Mountains where it appears to be constant. From Montreal, we have a fair series collected by our generous friend Mr. Sheppard. At Montreal this form occurs with the typical form. The classification "form" is based on this latter material; however, in the Riding Mountains, *ridingsii* occurs as a race. With sufficient material from the regions between the two locations, interesting theories could be formulated.

Holotype - ♂, June 23, 1938, Riding Mountains, Manitoba

Allotype - ♀, June 7, 1934, Riding Mountains, Manitoba

Paratypes – Riding Mountains, Sand Ridge, Man., and Montreal, P.Q.

### *Poanes hobomok wetona*

*Poanes hobomok wetona* was minimally described verbally and no illustration was provided. To my knowledge, the photos provided herein are the first published depictions of the holotype (Figs. 1-2). I have examined topotypical Massachusetts males of *hobomok* (Figs. 5/7) that are identical to typical males of *wetona*. It is the females of *wetona* that distinguish it as being distinct from nominate *hobomok*. Although some *hobomok* females also have considerable dorsal fulvous, the dark form *pocahontas* occurs frequently within northeastern US *hobomok* while this form is unknown from subspecies *wetona*. The southern Appalachian taxon described herein differs more from nominate *hobomok* and western *wetona* than those two differ from each other. Here is the OD of *wetona*.

*Poanes hobomok wetona* Scott, new subspecies. *Wetona* is somewhat paler than *P. hobomok hobomok* (Harris). The brown DFW and DHW borders are slightly narrower, the dorsal wing bases have less brown, and the brown dorsal spot beyond the FW cell is smaller (less brown). Few females are as dark as ssp. *hobomok*, and many females are as light as males; the black female form *pocahontas* common in eastern U.S. in ssp. *hobomok* is absent in *wetona*. I first discovered *wetona* in 1967. It has since been found common throughout the foothills of the Wet Mts. in southern Colorado, and also on Raton Mesa in New Mexico. It possibly occurs between these areas, west of La Veta for instance. These are its only Rocky Mtn. localities (although ssp. *hobomok* occurs in the Black Hills). It occurs in *Quercus gambellii – Pinus ponderosa* habitat. Types: Sand Gulch S. Greenwood, 7200', Custer Co. Colo. 30 May 1971 [leg.] Glenn Scott, holotype male, 4 m paratypes; North Creek 4 mi. NW Beulah, Custer Co. Colo. 29 June 1970 G. Scott 2m 1f, 30 June 1971 J. Scott, 11; Beulah, Pueblo Co. Colo. 12 June 1970 2m J. Scott; 2 mi. up Greenhorn trail, Pueblo Co. Colo. 22 June 1967 1f J. Scott; Soda Gulch S. Wetmore, Custer Co. Colo, 7400' 29 June 1971 40 J. Scott; Smith Creek Campground, Custer Co. Colo. 25 May to 6 July, 1970-1793, 48, J. Scott & G. Scott; N. Hardscrabble Creek 2 mi. S. Greenwood, Custer Co. Colo. 24 June 1968, 1f G. Scott; Slope between N. & middle Hardscrabble Creek, Custer Co. Colo. 30 June 1968 1f G. Scott; N. Hardscrabble Crk. E. of Harms Gulch, Custer Co. Colo. 30 June 1968 2m 3f G. Scott; middle Hardscrabble Crk. Custer Co. Colo. 1 July 1968 1f G. Scott; 2 mi. SW Oak Creek Cgd., Fremont Co. Colo. 7 July 1970 1f J. Scott; 5 mil SE Beulah, Pueblo Co. Colo. 18 June 1970 5m G. Scott; South Hardscrabble Crk. 7400', Custer Co. Colo. 30 June 1971 8 J. Scott; N. of Goodpasture, Pueblo Co. Colo. 5 May 1972 1m J. A. Scott; Raton Mesa, Colfax Co. New Mex. 4 July 1973 Allotype female, 13 m 3f paratypes J. Scott. 3m paratypes to New Mex. State Univ., others to many colls. [RG. The holotype was deposited in the LACM.]

## *Poanes hobomok monofacies:* New Subspecies

**Diagnosis. Males**. Both *P. h. hobomok* and *P. h. wetona* are broadly fulvous on the dorsal forewings. Some males of nominate *hobomok* have dark dusting at the base of the forewings, but never as extensive as in typical males of *P. h. monofacies.* Males of *P. h. monofacies* differ from all other *hobomok* populations in that many individuals have extensive dark brownish black scaling at the base of the forewings – this is especially noticeable in cell CU2 where the dark basal color extends well into the cell in some individuals reducing the fulvous area to a small spot. This is form *alfaratta* (Figs. 17 & 21) which was previously considered to only occur in females. *Monofacies* is thus the only subspecies where some males are darker than typical females. In *monofacies* the dark forewing margin is 3 to 5 mm wide, to 1/3 width of wing; in *hobomok* 1.5 to 3.5 mm wide, less than 1/4 width of wing. The fulvous area on the dorsal hindwing of *monofacies* is also reduced. This is most noticeable in cell CU1. On the ventral surface of both wings the outer ground color tends to be a uniform dark brown in *monofacies*; the hind wing central yellow patch is noticeably narrower (smaller) than in either *wetona* or *hobomok*, often occupying only about the middle one third of the wing surface. In typical *hobomok* from New England west through subspecies *wetona* the ventral outer ground color varies from medium brown to light yellowish brown with bluish-gray dusting; the central hind wing yellow patch often occupies over half the surface of the wing. The fringe on *monofacies* is usually brown while in the other subspecies it is usually orange. **Females.** In subspecies *monofacies,* the dorsal forewings are never extensively fulvous, while in subspecies *wetona* they almost always are, and frequently are in *hobomok* females. The *pocahontas* form is rare in subspecies *monofacies* but common in New England nominate *hobomok*. The ventral surface of *monofacies* females is similar to that of its males except that they are at times dusted with bluish-gray scales on the dark brown outer margins of the wings and the central yellow patch is even more restricted and at times absent. The dorsally yellow females of *hobomok* and *wetona* are usually well marked and more colorful ventrally (Figs. 4, 12 & 16).

**Description.** ***Male*** (Figs. 17/19, 21/23, 25/27): *Head, thorax, abdomen* and *legs*: In all anatomical features darker but of the same colors as in nominate *hobomok* except for the palpi which are as in nominate *hobomok* – grayish white at base blending to rusty tawny at terminal segment; palpi thus in more contrast with head and thorax in *monofacies*. *Forewings*: dorsally, outer margin dark brown 3 to 5 mm wide; base of wing usually with extensive brown, up to 8 mm into wing in cell CU2; fulvous area accordingly compressed so that many male *monofacies* are form *alfaratta*; ventrally, as above but fulvous and dark areas more sharply defined, base of wing black. *Hindwings*: dorsally, dark brown with restricted orange fulvous central patch, spot in cell CU1 small and never extending to base of vein (this spot usually extends to base of vein in *hobomok*), never a fulvous spot in cell CU2; ventrally, central area yellow patch occupying half or less of wing surface and strongly contrasting with dark outer brown ground, ground seldom with any yellowish dusting, fringe usually dark and concolorous with marginal area of wing with an inner thin black line. ***Female*** (Figs. 18/20, 22/24, 26/28): *Head, thorax, abdomen* and *legs*: as in male but slightly lighter. *Forewings*: dorsally, as in male but tending to less fulvous with most females being form *alfaratta*, individuals with only small spots (*pocahontas*) are uncommon; ventrally, as in male but outer marginal lighter and often with blue-gray dusting in apical area. *Hindwings*: dorsally, as in male, individuals with no fulvous uncommon; ventrally, as in male but central yellow patch more restricted and usually with blue-gray dusting on margins.

**Types**. *Holotype* ♂ (Figs. 17/19): NORTH CAROLINA: Macon County, near summit of Chestnut Mountain, 3,500', FS Rd. 4563, 22 May 2000, R. Gatrelle collector. *Allotype* ♀ (Figs.18/20): NORTH CAROLINA: Macon County, near summit of Chestnut Mountain, 3,500', FS Rd. 4563, 22 May 2000, R. Gatrelle collector. *Paratypes*: 31♂♂, 12♀♀: NORTH CAROLINA: Clay County: Buck Creek, 1♂, 18 May 2001, 1♂, 7 May 2002, 3♂♂, 24 May 2002, 1♂, 25 May 2002, Chunky Gal Mtn. at Hwy. 64, 1♂, 24 May 2002; Jackson County: Brushy Mtn., 1♂, 29 May 2000, Whiteside Cove Rd., 3100', 1♀, 30 May 2000 (form *pocahontas*); Macon County: visc. Jones Knob, 1♂, 27 June 1992, 4♂♂, 5♀♀, 4 June 1993, 1♀, 10 June 1994, 4♂♂, 1♀, 30 June 1994, 1♂, 22 May 2000, 4500', 4♂♂, 2♀♀, 16 May 2002, Chestnut Mtn., 1♂, 22 May 2000, Scaly Mtn. trail, off Turtle Pond Rd., 4100', 1♂, 1♀, 10 June 1993. GEORGIA: Walker County: Pigeon Mtn. Rec. Area, 1000', 19 km WSW of LaFayette, 4♂, 1♀, 2 May 1992, 3♂♂, 16 May 1998. The holotype and allotype are deposited in the LACM, Los Angeles, California; NC paratypes in the TILS collection Goose Creek, South Carolina; Georgia paratypes in collection of James Adams, Dalton, GA. All NC paratypes leg. R. Gatrelle; all GA paratypes leg. James Adams.

**Etymology**. The name means one face because the sexes look very much alike.

**Additional material examined**. In this study I examined specimens from the following locations. All specimens are nominate *hobomok* unless otherwise noted. Number of specimens by sex in [♂/♀]. **CANADA: MANITOBA:** Duck Mtns [1/2] (*ridingsii*), Riding Mtns. [ /1], Turtle Mtns. [1/1]; **ONTARIO:** Kitchner [ /2], Shequiadah [2/ ]; **NEW BRUNSWICK:** Edmundston [ /1]; **NOVA SCOTIA:** Armdale [8/2]. **UNITED STATES: MASSACHUSETTS:** Mt Holly [4/3], Melrose [3/2], Gardner [ /1]; **CONNECTICUT:** Middletown [1/ ], Kent [ /1]; **NEW HAMPSHIRE:** Coos Co. [4/ ]; **VERMONT:** Orange Co. [7/3]; **MAINE:** Lewiston [ /1], Brunswick [ /1]; **NEW YORK:** Staten Island [1/ ], Lk. Tiorrti [ /2], Catskills [4/1], Hartsdale [2/ ]; **NEW JERSEY:** Nutley [ /1]; **PENNSYLVANIA:** Bucks Co. [1/2], Green Lane Co. [1/1], Bedford [4/7], Flowertown [10/16], Montgomery Co. [8/8], Centre Co. [ /1], Lehigh Co. [3/3]; **MARYLAND:** Allegany Co. [3/2]; **WEST VIRGINIA:** Pocahontas Co. [ /1]; **ILLINOIS:** Lake Co. [8/1], Mc Hennery [3/ ]; **OHIO:** Geauga [1/1]; **MICHIGAN:** Lansing [ /1], Cass Co. [1/ ];

**WISCONSIN:** Marathon Co. [1/ ], Polk Co. [1/ ]; **MINNESOTA:** Lake Co. [1/ ]; **IOWA:** Lyon Co. [1/ ], Hardin Co. [12/8]; **NEBRASKA:** Cass Co. [2/1], Sioux Co. [1/1], Saunders Co. [ /1], Richardson Co. [4/4]; **MISSOURI:** Wayne Co. [3/2], Boone Co. [ /1], Holt Co. [ /4], Grundy Co. [6/4], Columbia [ /1]; **OKLAHOMA:** Craig Co. [3/ ]; **ARKANSAS:** Carroll Co. [4/3] (nr. *monofacies*), Washington Co. [ /1], Saline Co., Quachita Mtns. [1/ ] (nr. *monofacies*); **GEORGIA:** (all *monofacies*) Bibb Co. [ /1], Cobb Co. [1/ ], Allatoona Dam [1/ ], Pickens Co. [1 atypically light/1], Rabun Co. [2/ ]; **TENNESSEE:** (*monofacies*) Great Smoky Mtns. Park [ /1]; **COLORADO:** Custer Co. [3/ ] (*wetona*) (one a paratype: 7800', N. Creek, 30 June 1971); **NEW MEXICO:** (*wetona*) Colfax Co. [2/3].

[Note: data off museum labels was sometimes difficult to read or very incomplete. New Mexico, Nebraska and Manitoba specimens provided by Steve Spomer. Various specimens from northeastern states provided by Alex Grkovich. Colorado specimens in TILS collection. Remaining specimens in Florida State Collection of Arthropods.]

**Size.** *Monofacies* is the largest of the *Poanes hobomok* subspecies: male: average left FW: 16.5 mm from base to apex. (in MA *hobomok*: 13.5); female: average left FW: 17.5 (in MA *hobomok*: 14.5). In mounted specimens the average wing expanse (FW outer margin to margin) was: MA *hobomok*: males: 29 mm, females: 33 mm; NM *wetona*: males: 28 mm, females: 31 mm; NC *monofacies*: males: 33 mm, females: 36 mm. (n= per specimens listed above.)

**Comments**. The subspecies *hobomok, wetona* and *monofacies* can be summarized as follows. 1) *Hobomok* has the most variable females ranging from unmarked dark brown to very fulvous dorsally. Male *hobomok* are almost always (90%) quite fulvous dorsally. 2) *Wetona* has all males and nearly all females exhibiting extensive dorsal fulvous – form *pocahontas* does not occur in *wetona*. However, occasional females and many males of *wetona* are indistinguishable from nominate *hobomok*. 3) All *monofacies* females and many males are quite dark dorsally and ventrally, and look alike dorsally in range of variation. Largely fulvous females have never been observed in *monofacies* and only one form *pocahontas* female has been found. 90% of *monofacies* females are form *alfaratta*. Occasional male *monofacies* (<10%) are fulvous enough on the dorsal fore wing to be very similar to males of nominate *hobomok* (Fig. 25). These similar to *hobomok* males can usually be separated by the reduced fulvous on the dorsal hind wing in cell $CU_1$. 20% - 40% of males are form *alfaratta* in local populations.

While many of the samples were quite small, they nonetheless provided an accurate sample and pattern of how the Hobomok Skipper varies throughout its range. The specimens from Arkansas indicate that *monofacies* may extend into that state. Missouri material is largely typical *hobomok*. The Iowa series was very typical in phenotype but a bit larger than northeastern specimens. Maryland specimens were also larger but slightly darker than typical New England *hobomok*. Nebraska specimens were also larger and darker than populations in Iowa and Colorado, but still considered nominate *hobomok*. Austin notes one male with *monofacies* phenotype ex Iowa in his collection. This pattern indicates to me that *monofacies* was at one time an inhabitant of the southeastern mainland when Florida was an Island. This would have been across Georgia, Alabama and Mississippi.

The more I investigate the subspecific patterns in eastern US butterflies and skippers, the more I am convinced that most of the taxa in the northeastern US came from ancestors from the west and not often the southeast. The southeastern influence does not seem to go northward beyond New Jersey. North of Jew Jersey (esp. Remington's suture zone 1) many species are represented by different subspecies than occur south of that region (Remington, 1968; Gatrelle, 1999, 2000). My expectation is that DNA would show that *wetona* and *hobomok* are close relatives and *monofacies* more distant. *Wetona* and *monofacies* would then be the most direct descendants from two refugium. The darker populations in Oklahoma and Nebraska would be from gene flow moving from Arkansas northwest ward. A fascinating aspect of evolution is how multiple taxa will act both as species and subspecies in different regions. For example, it would not surprise me if *wetona* and *monofacies* act as species but both act as subspecies with nominate *hobomok*.

(In review, Austin mentioned possible circular speciation and provided several references including:

Anderson, L.C. 1984. Sympatric subspecies in *Chrysothamnus nauseosus*. Proceedings Symposium of the Biology of *Artemisia* and *Chrysothamnus*. Provo, Utah, July 9-13, 1984.

Wake, D.B., K.P. Yanev, and M.M. Frelow. 1989. Sympatry & hybridization in a "ring species": the plethodontid salamander *Ensatina eschscholtzii*. Pp.134-157 in Speciation and its Consequences (D. Otte and J.A. Endler, eds.). Sinauer, Sunderland, MA. 679 pp.)

My hypothesis on the origin of form *pocahontas* into *hobomok* is as follows. *Wetona* (which lacks the dark morphs) would have moved north and eastward as the Wisconsin ice sheet retreated while *monofacies* moved west and north (both following grasses). When *monofacies* genes interacted with *wetona* genes this gave rise to *hobomok* and its form *pocahontas* as it continued east (driven by the prevailing winds). Spomer reports no dark form females from Nebraska and I have not seen them in Iowa. They are found in Missouri. Thus, this hypothesized convergence would appear to have occurred in the lower Midwest and moved north and east from there (Mississippi and Ohio drainage). The presence of form *alfaratta* in *monofacies* males and scarceness of *pocahontas* in *monofacies* females is interesting. I have never seen a fully fulvous female of *monofacies*. Figure 26 is the most fulvous female *monofacies* I have found. A lot of interesting evolutionary and genetic things for someone to research in *wetona*, *hobomok*, and *monofacies*.

## ACKNOWLEDGMENTS

I thank the Los Angles County Museum (Julian Donahue and Brian Brown) for providing photos of the *wetona* holotype; Canadian National Collection (Don Lafontaine) for the original description of *ridingsii;* Steve Spomer, James Adams and Alex Grkovich for loan of important specimens; David Wright and George Austin for the original description of *hobomok;* Wright for detailed information on the Harris collection and notebook. Wright and Jonathan Pelham for literary historical information; Philip Perkins (MCZ) for information on MCZ types; Spomer and Austin for review of this document.

## LITERATURE CITED

ALLEN, T.J. 1997. The Butterflies of West Virginia and Their Caterpillars. Pittsburgh, PA: University of Pittsburgh Press xii + 388 pp.

BROWN, F.M. 1975. The third Edition of Thaddeus William Harris's "Treatise on Some of The Insects Injurious to Vegetation." 1862. Entomological News. Vol. 86, Nos. 3&4 1975. Pp 65-68.

CHERMOCK, F.H. & R.L. CHERMOCK 1940. Some New Diurnal Lepidoptera From the Riding Mountains and the San Ridge, Manitoba. Canadian Entomologist, 72: 83.

CLARK, A.H., and L.F. CLARK. 1951. The Butterflies of Virginia. Smithsonian Misc. Coll. 116 (7): vii + 239 pp.

GATRELLE, R.R. 1999. An Evolutionary Subspecific Assessment of *Deciduphagus henrici* (Lycaenidae) Based On Its Utilization of *Ilex* and Non-*Ilex* Hosts: Description of a Third *Ilex* Associated Subspecies. Designation of a Neotype and Type Locality for *Deciduphagus irus*. TTR, Vol. 1:6, 14 pp. The Int. Lepid. Survey, Goose Creek, SC.

_____. 1999. Hübner's *Helicta*: The Forgotten *Neonympha*. The Recognition and Elevation of *Neonympha helicta* (Nymphalidae: Satyrinae) to Specific Status. The Designation of Neotypes for *N. helicta* and *N. areolatus*. The Subspecific Transfer of *septentrionalis* to *helicta* and the Description of a Third *helicta* Subspecies From South Florida. The Taxonomic Report. Vol. 1:8, 8 pp. The Int. Lepid. Survey, Goose Creek, SC.

_____. 2000. Description of a New Subspecies of *Poanes aaroni* (Hesperioidea: Hesperiinae) the West Central Gulf Coast of the Southern United States. The Taxonomic Report. Vol. 2:2, 10 pp. The Int. Lepid. Survey, Goose Creek, SC.

HARRIS, T.W. 1862. A Treatise on Some of the Insects Injurious to Vegetation, third edition. Commissioners on the Zoological and Botanical Survey of Massachusetts: 313

ICZN (International Commission on Zoological Nomenclature). 1999. International Code of Zoological Nomenclature. 4th ed. London, 1999: The International Trust for Zoology Nomenclature, 306 pp.

REMINGTON, C.L. 1968. Suture-zones of Hybrid Interaction Between Recently Joined Biotas. Evol. Biology, Vol. 2 (8), 325- 413.

SCOTT, J.A. 1981. New Papilionoidea and Hesperioidea From North America. Papilio (New Series) No. 1: Nov. 25, 1981. 12 pp.

_____. 1986. The Butterflies of North America, A Natural History and Field Guide. Stanford Univ. Press, Stanford, CA. 583 pp.

Volume 3 15 December 2002 Number 9

The Taxonomic Report
OF THE INTERNATIONAL LEPIDOPTERA SURVEY

# TAXONOMY AND DISTRIBUTION OF BUTTERFLIES (PAPILIONOIDEA) OF THE SKARDU REGION, PAKISTAN

Muhammad Abbas [1], Dr. Muhammad Ather Rafi [2], Dr. Mian Inayatullah [3]
Dr. Muhammad Rafique Khan [4], Harry Pavulaan [5]

**ABSTRACT.** A study was conducted in six different localities around Skardu to document the butterfly fauna of that region. The study revealed that 16 species in 5 families and 14 genera occur in the area. The families include: Papilionidae (represented only by the genus *Parnassius*); Pieridae (genera *Pieris, Pontia* and *Colias* are represented); Lycaenidae (genera *Lycaena*, *Everes*, *Aricia*, *Plebejus*, *Zizeeria* and *Zizina* are represented); Nymphalidae (only two genera, *Aglais* and *Cynthia* are represented); and Satyridae (represented by the genera *Pararge* and *Maniola*).

## INTRODUCTION

Butterflies have been studied systematically since the early 18th century and 19,238 species had been documented worldwide by 1998 (Heppner, 1998). This figure is not constant because of the continuous discovery of new butterflies (Goodden, 1977; Stokoe, 1974; Green and Huang, 1998), and also due to ongoing disagreements between taxonomists over the status of many species.

The distribution of butterflies involves both expanding and contracting ranges. Natural changes in the distribution of species can be difficult to deduce because they tend to be slower and subtler than the dramatic changes caused by man. Unfortunately, most expanding ranges involve introduced species and most contracting ranges are due to the destruction of natural habitats (Lafontaine, 1997). Expansion in a species' range may often be in response to human activities favoring these species, making these butterflies opportunists. In order to document such temporal changes over time, a baseline faunal inventory must first be established.

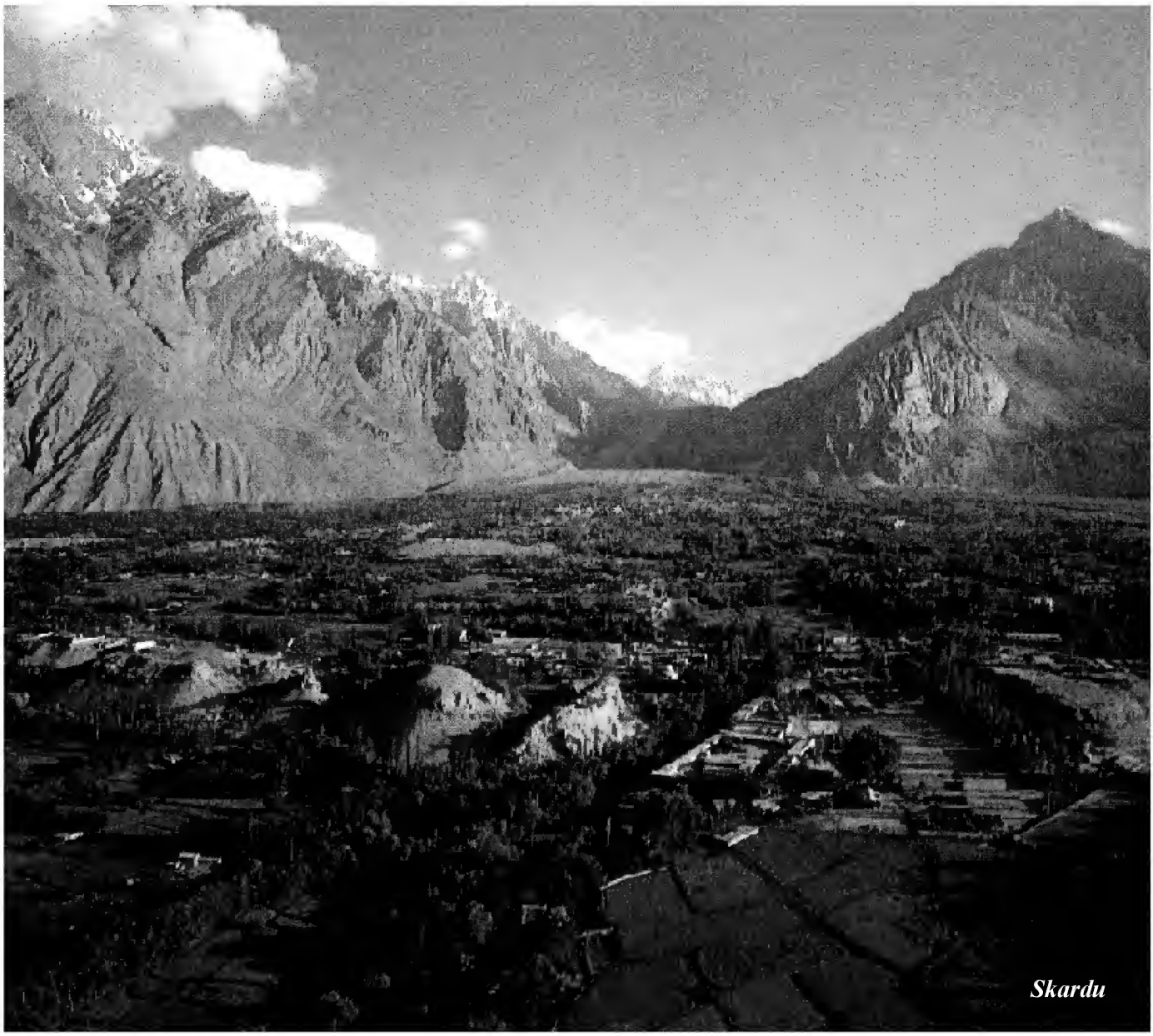
It is essential that we document the butterfly fauna of certain regions so that steps may be taken to ensure the survival of these fascinating creatures for future generations. There is little that can be done to save our butterflies once their habitats are destroyed. Thus, it is important to manage our environment and avoid further damaging the already fragile balance of nature (Whalley, 1992).

In spite of their aesthetic appeal, we have comparatively little information on the butterfly fauna of many regions of Pakistan, especially Skardu. No documented collections had been made or faunal surveys conducted in this rather remote region prior to this study. The region known as the Northern Areas of Pakistan is spread over a vast area of 74,200 sq. km. It lies beside the lofty peaks and great mountainous ranges of the Karakorams, Hindu Kush, Himalayas and Pamir, which are largely uninhabited. Within this

[1] Kara Koram Agriculture Research Station, Pakistan Agriculture Research Council, Skardu, Pakistan
[2] Pest Management Research Programme (PMRP), Institute of Plant and Environment Protection (PMRP), Islamabad-45500, Pakistan.
[3] Department of Entomology, North West Frontier Province (N.W.F.P.) Agricultural University, Peshawar, Pakistan.
[4] Department of Entomology, University College of Agricultural, Rawalakot, Azad Kashmir, Pakistan.
[5] Research staff member, The International Lepidoptera Survey, Herndon, Virginia, U.S.A.

area, the Skardu Region covers an area of 28,850 sq. km. with a population of 272,000 (census, 1986). Elevations in the study area range from approximately 2,270 m. along the river Indus to over 4,000 m. on the Deosai Plains, with Skardu city itself at 2,438 m. Skardu is well known for its peculiar geographical and climatic conditions. The climate is temperate and very arid. In summer the temperature reaches to a maximum of 35.2°C while the minimum temperature in winter is around -25°C.

Most settlements in the region occur along rivers and are built on alluvial deposits. With irrigation, crop agriculture is possible. The people of Skardu are largely subsistence agriculturists, but crops are produced for market as well. Skardu is famous not only for its beautiful scenery, but due to the temperate climate it also holds its place as a commercial fruit production region for Pakistan and abroad, producing cherries, almonds, apricots, apples, pears, peaches, grapes, plums, mulberries, among others. Important regional crops are wheat, maize, barley, alfalfa, barseem, potatoes, tomatoes, turnips, cabbages and carrots (agricultural statistics, 1993-94). Thus, the settled areas contain largely disturbed habitat. The surrounding region, most of it arid, is thinly populated by shepherd farmers.



*Skardu*

The present study was conducted to document for the first time the butterfly species in Skardu. The objectives of this study were foremost to study the distribution and diversity of butterflies in various habitats found in the region.

## REVIEW OF LITERATURE

### Distribution Studies

Despite their great importance to researchers, aesthetic value to lepidopterists and despite numerous studies of butterflies on the Indian subcontinent, there is very little information on the butterfly fauna of Pakistan and especially about the Skardu region. Thus, literature references are relatively scarce.

Doherty (1886) explored the butterfly fauna of Kashmir for the first time. Swinhoe (1887) reported 4 families of butterflies from Karachi and neighboring areas, including Papilionidae (4 species), Lycaenidae (18 species), Nymphalidae (17 species), and Hesperioidea (7 species).

Marshal and de Niceville (1883-1890) worked on the butterfly fauna of the Indian sub-continent. Leslie and Evans (1903) reported the butterflies of Chitral. Bingham (1905) and Lefroy (1909) reported on butterflies from the Indian region. Rhe-philipe (1917) reported 5 families from Lahore, including Papilionidae (3 species), Pieridae (17 species), Lycaenidae (11 species), Nymphalidae (16 species) and Hesperioidea (7 species). In another study, Evans (1923) explored the butterfly fauna of the Indian region.

Puri (1931) explored the butterfly distribution of Lahore. He reported 57 species belonging to 34 genera and 5 families. Similarly Evans (1933) studied the butterfly fauna of Baluchistan. Talbot (1939) and Wynter-Blyth (1940-1957) described the butterfly fauna of the Indian subcontinent. Menesse (1950) worked on the butterflies of Sind.

Malik (1970) reported 8 species of butterflies from Rawalpindi and Murree. In another study Malik (1973) reported 9 families of butterflies from West Pakistan, including Papilionidae (9 species), Pieridae (21 species), Lycaenidae (21 species), Nymphalidae (19 species), Satyridae (1 species), Danaidae (9 species), Acaeridae (1 species), Erycinidae (2 species) and Hesperioidea ( 9 species). Ahsan and Iqbal (1975) reported 66 species of butterflies from Lahore, belonging to 44 genera and 7 families, among which 12 species were reported for the first time from Lahore. Iqbal (1978) recorded 51 species in 35 genera and 8 families from Rawalpindi and Islamabad, including: Papilionidae (3 species), Pieridae (12 species), Lycaenidae (7 species), Nymphalidae (11 species), Satyridae (6 species), Danaidae (3 species), Erycinidae (3 species) and Hesperioidea (5 species).

Hasan (1994) explored the fauna of Islamabad and Murree, reporting Papilionidae (4 species), Pieridae (13 species), Lycaenidae (11 species), Libytheidae (1 species), Nymphalidae (17 species) and Danaidae (3 species). More recently, Hasan (1997) reported 80 butterfly species in 9 families from Northwest Himalaya (Galgit and Azad Kashmir), including Papilionidae (6 species), Pieridae (15 species), Lycaenidae (17 species), Libytheidae (1 species), Nymphalidae (24 species), Satyridae (8 species), Danaidae (3 species), Erycinidae (1 species) and Hesperioidea (5 species). In another attempt, Smith and Hasan (1997) reported 50 species from Northern Pakistan (Gilgit to Khunjerab). Khan, et al. (2000) studied the distribution and diversity of genus *Papilio* in Rawalpandi and Islambad. Most recently, Rafi, et. al. (2000) published a guide to the Papilionidae of Pakistan.

### Taxonomy

The field of lepidopteran taxonomy is dynamic and the status of a great many named taxa or their higher level placement have been changed, many of them several times since their original descriptions. Little actual taxonomic work pertaining to the Lepidoptera of Pakistan has been done. Puri (1931) did systematic studies of the butterflies of Lahore. Ahsan and Iqbal (1975) prepared a revised list along with keys and brief description of the species recorded in Lahore. Similarly, Iqbal (1978) conducted a systematic account of the butterflies of Rawalpindi and Islamabad.

## MATERIALS AND METHODS

During April 1999, six sites were selected for extensive sampling to determine the distribution, diversity and taxonomy of butterflies in Skardu (map pg. 14). The five localities were Skardu city, Shigar village, Kharmang village, Sadpara village, Kachura village and the Deosai Plains. These localities were selected on the basis of their position in topographic elevation, vegetation and accessibility.

In the center of the study area is Skardu city (photo page 2). The city lies on the banks of the river Indus amidst the towering mountains of the Karakoram range. Skardu city lies at the site of an oasis situated on an arid geological tableland 8 km. wide by 32 km. long. The landscape is made uneven by ancient sand dunes. Willows, poplars and the oriental plane tree grow here naturally among the cultivated apricots, peaches, mulberries, apples, pears, plums and cherries (Stewart, 1982). Grapes, vegetables and a variety of field crops are also widely cultivated.

Shigar village is about 32 km. to the north of Skardu along the banks of the river Shigar. It is situated within the lush green Shigar valley, an oasis which is surrounded by towering snow clad peaks. The valley is known for its crops of grapes, pears, apples, walnuts, peaches and apricots.

Kharmang village lies far to the southeast along the river Indus. It is situated near Kachura Lake, known for multitudes of wildflowers which line its shores in spring. Peaches, apricots, pears and apples are grown here.

The Deosai Plains (Fig. 1) south of Skardu are located on one of the world's highest plateaus, roughly 56 km. long by 40 km. wide, averaging 4,116 m. and are encircled by the Himalayan Mountains which reach heights of over 5,500 m. The cold alpine climate causes the plains to be snowbound under deep snows from November to May (Stewart, 1982). During the summer months, though arid due to a lack of rain, it becomes a morass of swamps from the melted snow much as the arctic tundra. Although above tree line, it is characterized by rich alpine snowmelt flora as evidenced by the abundance of flowering plants that make the plains glow with bright colors through the summer months. This region is uninhabited and much of it is now within Deosai National Park. The primary area of study here was at Burzil Top.

Kachura village (Fig. 2) is about 32 km. to the northwest of Skardu near the river Indus. Like the other areas, oasis conditions and irrigation support vegetation and cultivated crops. Without irrigation, such areas would quickly revert to arid steppe-like conditions.

Sadpara village (Fig. 3) lies directly south of Skardu on the way to the Deosai Plains. Here too, native vegetation is primarily found in oasis conditions and cultivation is totally dependent on irrigation.

Butterfly specimens were collected by means of netting within one square kilometer at each sample site. Each site was sampled for 30-60 minutes per visit at intervals of 10-15 days throughout the study period, from April 1999 until the end of September 2000. Four hundred specimens were vouchered, which were mounted for positive identification. Each specimen was labeled with (a) place of capture, (b) date of collection, (c) scientific name, (d) family name, and (e) collector's name. The specimens were identified with the help of available literature and already identified specimens from different collections of the country, such as the Institute of Plant and Environment Protection (IPEP), Islamabad, and Pakistan Forest Institute, Peshawar. All the identified specimens from this study have been deposited in the entomological collection of the Entomology Department, NWFP Agricultural University, Peshawar and Institute of Plant and Environment Protection (PMRP), Islamabad.

## RESULTS

The present work is based on the collection of butterflies conducted in the study area during the years 1999 – 2000. Specimens were collected from various localities around Skardu. More than four hundred specimens were collected which were identified to species level. The survey revealed 16 species in 14 genera and 5 families, which occurred in the study areas. No species of the superfamily Hesperioidea (Latreille) were recorded.

## Species Recorded

## Superfamily **Papilionoidea** Latreille, 1809

### Family **Papilionidae** Latreille, 1809

The *Papilionidae* consist of two major subfamilies: the *Papilioninae* Latrielle and the *Parnassiinae* Duponchel. The Swallowtails (*Papilioninae*) are large, usually dark coloured butterflies that have the radius in the front wing five-branched. Most genera contain tailed species. These groups are not represented in the Skardu region. The Parnassians (*Parnassiinae*) are medium-sized, having very rounded wings usually white or gray with dark markings, the radius in the front wing is four-branched, and there are no tail-like prolongations on the hindwing. Females are unique among the butterflies in that they carry a distinct hardened pouch or "phragis" beneath their abdomen, which is produced by the male immediately after mating, to prevent other males from mating with the female. Only one species in genus *Parnassius* of this family has been recorded in the study area.

### Subfamily **Parnassiinae** Duponchel, 1835

### Tribe **Parnassiini** Duponchel, 1835

### Genus ***Parnassius*** Latreille, 1804

The Apollo Butterflies are medium-sized, usually white or gray with dark markings, and with rounded, often translucent wings. Many species are adorned with red eyespot markings on the wings. They are also typically found in arctic/alpine habitats. Interestingly, only one species of this genus was recorded in the study area. It is frequently found with other members of the genus.

***Parnassius charltonius*** Gray, 1853 - Regal Apollo (Figs. 8 & 9)
**Wingspan:** 80-90 mm.
**Female:** Forewing with vein $R_2$ from $R_5$; veins $M_1$ and $R_5$ well-separated at the origin; discal band usually broadened below the cells; the bases of areas $Cu_{1b}$ and $Cu_{1a}$ being usually entirely black; no red spot. Hindwing without a spot at base of area $R_3$; a small red or black spot at the middle of area $R_3$; a very large red ocellus extending from vein $M_3$ to vein $M_1$, usually white-centered; a red or black basal bar above the anal angle in area 1 and $Cu_{1b}$; a complete row of very distinct bluish-white centered black submarginal spots on a dark ground; a narrow black marginal line, more or less interrupted at the veins. Female phragis is heliciform (snail-shaped), being rolled upon itself, and furnished with a wide and longitudinal shallow groove. Females are larger and wings are more diaphanous (transparent) than the male.
**Male:** Smaller, and wings generally less diaphanous (transparent) than the female.
**Flight period:** July–August.
**Distribution & Habitat:** This butterfly is broadly distributed over the mountain ranges of central Asia, but within the study area was found only in restricted locations at Burzil Top in the Deosai Plains region, at elevations above 4,250 m. Previously reported from nearby Chitral by Mani (1986). Leslie and Evans (1903) recorded it from Shandur and the Burzil pass. The habitat includes mountain passes and steep rocky or clay slopes near glaciers. Males have been observed patrolling along cliff faces. Females are known to descend to a lower elevation than the males.
**Taxonomy:** About 20 subspecies are described, however specimens from the study area have not been identified to subspecies.
**Comments:** The larvae are known to feed on species of *Corydalis* in other portions of the species' range.

### Family **Pieridae** Duponchel, 1832

This family includes small to moderately sized butterflies of mainly white, yellow or orange ground color bearing a variety of black margins, spots or other markings. They are characterized by pronounced sexual dimorphism and seasonal variation. Antennae gradually stouter towards the tip; there are six normally developed legs, fore tibia without cleaning spur, claws bifid; wings generally rounded, cell closed in both wings, one anal vein; hind wing with pre-costal vein or with a very short one turned towards wing base apically, two anal veins. They are also generally known to be species of open areas. Six species in three genera of this family were recorded in the study area.

## Subfamily **Pierinae** Duponchel, 1832

## Tribe **Pierini** Duponchel, 1832

## Genus ***Pieris*** Schrank, 1801

This genus, traditionally known as the "Whites" consists of about 30 similar-appearing species, several of which are difficult to distinguish. These are all white with varying degrees of development of similar spots on the wings. There is considerable disagreement between taxonomists over the status of several of these. Two species of this genus were recorded in the study area.

***Pieris rapae*** (Linnaeus, 1758) - Small White
**Wingspan:** 45-55 mm.
**Female:** Upperside white, bases of both wings and costa of forewing for a short distance sparsely dusted with black. Forewing with blackish gray apex; two round black spots at the middle of cells $M_3$ and $CuA_2$. Hindwing with a small diffuse black spot in area $Sc+R_1$ near hindwing apex. Underside forewing white; apex cream yellow with black spots in cells $M_3$ and $CuA_2$ corresponding to the upperside. Hindwing cream yellow, suffused with black dusting that is more evident in the spring. Very similar to *P. brassicae* (Linnaeus), but mainly smaller in size.
**Male:** Upperside as in female except black markings considerably reduced; spot in cell $CuA_2$ generally absent. Underside like female.
**Flight period:** April–September.
**Distribution & Habitat:** This widely distributed Holarctic species has been recorded in all localities in the study area. Leslie and Evans (1903) reported *Pieris rapae* from Chitral, while Malik (1970) reported it from Murree and Quetta, but the species is generally known to occur throughout Pakistan. It is common in cultivated areas and around settlements.
**Taxonomy:** The subspecies *debilis* (Alpheraky, 1889) has been described from the region north and west of here.
**Comments:** Malik (1970) reported a number of plants in family *Cruciferae* as host of this species in Murree and Quetta.

***Pieris brassicae*** (Linnaeus, 1758) - Large White
**Wingspan:** 57-66 mm.
**Female:** Upperside white. Forewing with broad black gray apex, extending back along the margin; two round black spots at the middle of cells $M_3$ and $CuA_2$; gray edge along the inner margin along the hindwing in cell 1A+2A. Hindwing with a small black spot in area $Sc+R_1$ near hindwing apex. Underside forewing white; apex dirty cream yellow with black spots in cells $M_3$ and $CuA_2$ generally fused together across cell $CuA_1$. Hindwing cream yellow, variably suffused with grayish scaling. Very similar to *P. rapae* (Linnaeus), but mainly larger in size.
**Male:** Upperside similar to the female but without any spots on forewing above. Underside like the female except the two forewing spots in cells $M_3$ and $CuA_2$ remaining distinct.
**Flight period:** April–September.
**Distribution & Habitat:** Common in all localities in the study area. It is also widely distributed throughout much of the Palearctic region. In Pakistan, it is found in both plains and hilly regions but frequents cultivated areas, settlements, flowery areas, fields and mountain meadows. Interestingly, this butterfly is known to be highly migratory in some regions, both by latitude and by altitude. It is apparently incapable of overwintering at higher elevations in the mountains. Altitudinal migrants repopulate the mountainous areas each spring.
**Taxonomy:** Iqbal (1978) reported *P. b. nepalensis* Gray, 1846 as the subspecies from northern Pakistan. This subspecies is morphologically similar to nominotypical *P. brassicae* but it is smaller in size.
**Comments:** Lesile and Evans (1903) reported it from Chitral, while Rhe-philipe (1917) and Puri (1931) reported it from Lahore. Talbot (1939) reported it from Balochistan. Malik (1970) reported it from Rawalpindi, Hassanabdal, Abbottabad and Peshawar. Ahsan and Iqbal (1975) reported this species from Lahore. Iqbal (1978) reported it from Rawalpindi and Islamabad. Hasan (1994) reported this species from Islamabad and Murree Hills. He described cabbage, cauliflower, radish and mustard as host plant of this species. Hasan (1997) again reported this species, this time from the northwest Himalayas.

## Genus ***Pontia*** Fabricius, 1807

A group of similar-appearing species, all white with a series of black or gray markings on the upper surface. Undersides generally display heavy greenish gray patterns on yellow or white ground color. One species of this genus was recorded in the study area.

***Pontia callidice*** (Hübner, 1800) - Peak White
**Wingspan:** 45-55 mm.
**Female:** Upperside forewing white with extensive black apical markings mainly in the outer portion of the wing and a large black discocelluar mark; hindwing white with grayish appearance and a partially-developed band of black submarginal crescents. Underside forewing white with pattern of gray markings and greenish-yellow coloration near the apex; hindwing greenish-yellow with extensive gray pattern mainly aligned with the veins.
**Male:** Similar to the female but upperside much whiter; with black discocellular mark, and black submarginal markings considerably more reduced than in the female.
**Flight period:** June–August.
**Distribution & Habitat:** Found in only one locality near the permanent snow line on high alpine mountains, above 4,250 m. in northern areas of the Deosai Plains. It is rare. Known from tundra and cold steppe habitats from other parts of its range.
**Taxonomy:** Specimens are closest to subspecies *hinducucica* Verity, 1911, described from the Pamirs.
**Comments:** Prior to this study, *Pontia callidice* was not known from Pakistan. It was first discovered by the authors from the study area. It can be concluded that this species is not widely distributed in the country, and found only in restricted habitats.

## Subfamily **Coliadinae** Swainson, 1827

## Tribe **Coliadini** Swainson, 1827

## Genus ***Colias*** Fabricius, 1807

Primarily a holarctic genus but with representatives as far south as South America and Africa. Most species are hues of orange or yellow, some greenish, many with heavy gray suffusion. Only a few species are white in both sexes, many have white female forms. There is marked sexual dimorphism in most species, and great individual variation, leading to a great number of named forms. Two species of this genus were recorded in the study area.

***Colias erate*** Esper, 1805 - Eastern Pale Clouded Yellow (Fig. 5)
**Wingspan:** 40-60 mm.
**Female:** This is a highly variable species. Normal ground color is yellow but some females are of the white form *pallida* (Staudinger and Wocke, 1861). Upperside forewing with prominent black discocellular spot; broad black marginal area contains a row of several spots of the ground color; wing fringes reddish; hindwing black margin incomplete and broken at veins; discocellular spot orange or creamy white. Underside "olivaceous" yellow, hindwing dusted; forewing marginal postmedian area with band of black spots fading toward apex; hindwing discocellular spot pearly white, ringed with reddish.
**Male:** Similar to the female but with forewing marginal band narrower and hindwing black margin more complete. Ground color yellow. Upperside forewing with prominent black discocellular spot, marginal area black with band of yellow spots; hindwing with orange discocellular spot. Underside as in the female.
**Flight period:** July–September.
**Distribution & Habitat:** Widely distributed in all localities except the Deosai Plains. The species is an inhabitant of meadows and fields at lower elevations but is also found in a variety of montane and steppe habitats and around settlements.
**Taxonomy:** Specimens have been identified to subspecies *lativitta* Moore, 1882.
**Comments:** Reported by Swinhoe (1887) from Karachi. It is now known from several areas of northern Pakistan. This highly polymorphic species has many described forms and can often be confused with several similar-appearing species.

***Colias fieldii*** Ménétriés, 1855 - Dark Clouded Yellow (Fig. 6)
**Wingspan:** 45-55 mm.
**Female:** Upperside deep orange. Forewing with broad black marginal area containing several orange-yellow spots; prominent black discocellular spot; base of forewing heavily suffused with grayish green scales. Hinwing heavily suffused with dark grayish green scales; wide black marginal area containing a band of orange-yellow spots; prominent double discocellular orange spot. Underside greenish yellow; wing margin prominently edged with pink; hindwing with prominent silver double discocellular spot encircled with pink scaling.
**Male:** Similar to the female except upperside black margins more sharply-defined, lacking the orange-yellow spots.
**Flight period:** June–August.
**Distribution & Habitat:** Widely distributed, found in all localities. This is a south Palaearctic species occuring primarily in the Hamalayas and is found throughout much of northern Pakistan. This is a common species of the arid-montane oases where cultivation is practiced.
**Taxonomy:** The nominotypical subspecies occurs here.

**Comments:** Leslie & Evans (1903) first reported this species from Chitral. Puri (1931) reported it from Lahore. Malik (1970) reported this species from Lahore, Abbottabad, Karachi and Peshawar. He recorded *Indigofera dosua* as food plant for this species. Ahsan and Iqbal (1975) reported it from Lahore, while Iqbal (1978) and Hasan (1994) reported it from Rawalpindi, Islamabad and the Murree Hills. Hasan (1997) reported it from the northwest Himalayas. Hosts are cultivated *Fabacaea* sp.

## Family **Lycaenidae** Leach, 1815

These are small delicate butterflies, displaying a diverse range of colors from browns to bright blue or coppery-orange hues, and often have brilliantly colored uppersides. There is considerable sexual dimorphism as evidenced by the uppersides (the undersides of both sexes are usually identical). Males are generally more brightly colored while the females are usually duller in appearance. Some species are quite common but found as localized colonies adapted to very specialized habitats. The body is slender, the antenna is usually ringed with white, and there is a ring of white scales encircling the eyes. The front legs of the female are normal, but in males they are shorter and lack tarsal claws. Six species in six genera were recorded in the study area.

### Subfamily **Lycaeninae** Leach, 1815

### Genus ***Lycaena*** Fabricius, 1807

This genus consists of many coppery-orange butterflies, thus the familiar name "Coppers". One species of this genus was recorded in the study area.

***Lycaena phlaeas*** (Linnaeus, 1761) - Small Copper (Fig. 4)
**Wingspan:** 26–30 mm.
**Female:** Upperside: forewing pale reddish-copper adorned with several prominent black spots; black borders. The upperside of the hindwing grayish brown with broad orange marginal band; frequently with a row of faint blue spots inwards of this marginal band; a row of black marks bordering the outer edge of the orange margin. Underside: forewing with orange ground color adorned with black marks; apex brownish fawn; the entire hindwing brownish fawn with very small black spots.
**Male:** Similar to the female but slightly smaller.
**Flight period:** June-September.
**Distribution & Habitat:** Skardu city, Kachura and Sadpara. This species is known from meadow habitats and often frequents habitats disturbed by humans.
**Taxonomy:** Subspecies *comedarum* Grum-Grshimailo, 1890 has been named for this region.
**Comments:** A common butterfly of areas disturbed by humans, mainly utilizing various *Rumex* as the larval host.

### Subfamily **Polyommatinae** Swainson, 1827

### Tribe **Zizeerini** Chapman, 1910

### Genus ***Zizeeria*** Chapman, 1910

This genus consists of very small, dark blue and brown butterflies differentiated from other genera of "Blues" by minor wing and genitalic structures. Antenna slightly less than half the length of forewing; club elongate; concave on the underside. One species of this genus was recorded in the study area.

***Zizeeria knysna*** (Trimen, 1862) - African Grass Blue.
**Wingspan:** 16-20 mm.
**Female:** Upperside dull brown, markings altogether absent; forewing with basal patches of purple. Underside is pale grayish brown adorned with a series of small black spots.
**Male:** Similar to the female but violet blue color above and wide, dark wing margins.
**Flight period:** June–August.
**Distribution & Habitat:** Widely distributed in all localities except the Deosai Plains. This small butterfly is found along damp streamsides at lower elevations.
**Taxonomy:** The subspecies *karsandra* (Moore, 1865) has been identified for this region.

**Comments:** *Zizeeria knysna* was first reported by Swinhoe (1887) from Karachi. Hasan (1994) reported it from Islamabad and the Murree hills, and again recently (Hasan, 1997) from the Murree foothills. The host plants have been reported to be *Polygonum plebejum* and *Amaranthus spinosus* (Hasan 1997). This species is widely distributed only in the eastern part of Pakistan according to available literature, and is widely distributed in the Skardu region.

## Genus ***Zizina*** Chapman, 1910

This genus also consists of very small blue and brown butterflies. They are differentiated from other genera of "Blues" by minor wing and genitalic structures. One species of this genus was recorded in the study area.

***Zizina otis*** (Fabricius, 1787) - Lesser Grass Blue
**Wingspan:** 30-40 mm.
**Female:** dull brown with a slight suffusion of blue towards the wing bases. The underside of both sexes pale gray with brown markings.
**Male:** Similar to the female, but dark lilac-blue.
**Flight period:** May–September.
**Distribution & Habitat:** Skardu city, Kharmong and Kachura, being found generally at lower elevations. It is very rare in other portions of Pakistan, elsewhere being found only in Chitral.
**Taxonomy:** Many subspecies have been described from the Oriental (Indo-Australian) zoogeographical region but none have been described from this region. Until more research is done, our populations are attributable to the nominotypical subspecies.
**Comments:** *Zizina otis* was first reported by Leslie and Evans (1903) from Chitral at low elevation. Later on it was also reported by Rhe-philipe (1917) from Lahore. Despite the fact that this species is not widely distributed in Pakistan, it is widely distributed in Skardu.

## Tribe **Everini** Tutt, 1907

## Genus ***Everes*** Hübner, 1819

The species in this small Holarctic genus are distinguished primarily by short, hairlike tails on the hindwings. Males are generally blue while females are generally brown. Some authors consider *Everes* a subgenus of *Cupido* Schrank, 1801. One species of this genus was recorded in the study area.

***Everes argiades*** (Pallas, 1771) - Short-tailed Blue
**Wingspan:** 25-30mm.
**Female:** Upperside brown with two orange-ringed spots near tornus of hindwing. Underside pale gray with numerous small black spots. Spring brood females often have some blue suffusion at base of forewing.
**Male:** Upperside bluish-violet color. Underside like the female. Interestingly, the males are larger than the females.
**Flight period:** June-July.
**Distribution & Habitat:** Skardu city, Shigar. Found in meadow habitats.
**Taxonomy:** The subspecies *hellotia* Ménétriés, 1857, has been identified for this region.
**Comments:** Prior to this study, *Everes argiades* was not known from Pakistan. It was first discovered by the authors from the study area.

## Tribe **Polyommatini** Swainson, 1827

## Genus ***Aricia*** Reichenbach, 1817

This genus is characterized by both sexes being either all brown or brown with submarginal rows of orange lunules on all wings. There are only minor genitalic differences from other related genera. One species of this genus was recorded in the study area.

***Aricia agestis*** (Denis & Schiffermüller, 1775) - Brown Argus or Orange Bordered Argus
**Wingspan:** 25-30 mm.
**Female:** Upperside dark brown with prominent submarginal row of orange crescents on all wings. Underside brownish gray with numerous black spots and row of orange crescents like that of the upperside.

**Male:** Like the female except orange crescents are greatly reduced.
**Flight period:** May–August.
**Distribution & Habitat:** Sadpara, Skardu city and Kachura. The species is known from dry meadow habitats and broad open habitats.
**Taxonomy:** Specimens appear to be of the nominotypical subspecies.
**Comments:** In this species, it is often difficult to distinguish males from females by the wings alone.

## Genus ***Plebejus*** Kluk, 1802

In this genus, males are usually blue while the females are brown with orange submarginal lunules, usually on the hindwings. One species of this genus was recorded in the study area.

***Plebejus argus*** (Linnaeus, 1758) - Silver-studded Blue
**Wingspan:** 20-30 mm.
**Female:** Brown with submarginal orange lunules on hindwing. There may be varying amounts of blue basal suffusion in some individuals. The underside is grayish brown with black spots and marginal orange markings.
**Male:** Similar to the female but deep purplish blue above.
**Flight period:** June–August.
**Distribution and Habitat:** All localities except the Deosai Plains. Known from a variety of open habitats including meadows, steppes, mountain slopes and also frequenting settled areas.
**Taxonomy:** The subspecies *pamira* (Forster, 1936) has been identified for this region.
**Comments:** Prior to this study, *Plebejus argus* was not known from Pakistan. It was first discovered by the authors from the study area.

## Family **Nymphalidae** Swainson, 1827

These are medium-sized butterflies, with variable and elaborate markings, bright colors and angular-shaped wings. The hindwings of most species have a concave "channel" along the inner margin, which covers the abdomen when resting. The forelegs of both males and females are short, lack claws and are therefore useless for walking (only the middle and hind legs are used for walking). The forelegs are also clothed with long hairs, hence the name "Brush-footed Butterflies". These butterflies are known for their abilities of sustained flight over long distances and members of several genera hibernate as adults in cold regions. Only two species in two genera have been recorded in this family in the study area.

## Subfamily **Nymphalinae** Swainson, 1827

## Tribe **Nymphalini** Swainson, 1827

## Genus ***Aglais*** Dalman, 1816

This is a distinct genus of medium-sized butterflies characterized by bright reddish uppersides marked with a series of bold black or dark brown markings, yellow markings and marginal blue lunules on the hindwings. The undersides are characterized by shades of brown, heavily mottled to resemble tree bark. Authors frequently err in assigning these species to other genera, such as *Vanessa* or *Nymphalis*. One species of this genus was recorded in the study area.

***Aglais cashmiriensis*** (Kollar, 1844) - Kashmiri Tortoiseshell (Fig. 7)
**Wingspan:** 55-65 mm.
**Female:** Upperside orange-red with black and some pale yellow markings; underside mostly brown. The wings have a characteristic sculptured, angular appearance, with a ragged edge and characteristic tail stub.
**Male:** Similar to the female.
**Flight period:** May–June.
**Distribution and Habitat:** Skardu city and Shigar. Found in almost any habitat type and around settlements.
**Taxonomy:** The subspecies *nixa* Grum-Grshimailo, 1890 has been identified for this region.

**Comments:** Hasan (1994) reported this species for the first time, from Islamabad and the Murree Hills. Later, Mani (1986) reported this species from Murree Hills and Azad Kashmir. In the current study, it was collected from only two localities of Skardu. This shows that *Aglais chashmirensis* occurs only in some hilly areas and is not widely distributed.

## Genus ***Cynthia*** Fabricius, 1807

This genus, which is primarily Nearctic, includes several similar-looking species including the cosmopolitan *C. cardui*. It differs from the darker colored members of the genus *Vanessa* Fabricius, most significantly in features of the male and female genitalia and in egg morphology (Field, 1971). A single species of this genus was recorded in the study area.

***Cynthia cardui*** (Linnaeus, 1758) - Painted Lady.
**Wingspan:** 54-62 mm.
**Female:** Forewing above tawny orange brown (rosy hue in freshly-emerged individuals but fading with age) with dark brown markings; apex dark, containing several white markings including apical spots and a subapical bar. Hindwing similarly orange brown with dark markings; basal area pale brown, covered with fine hairs; band of five black submarginal ocelli. Underside forewing pale rosy orange; with a complex pattern of brown, gray, black and white markings. Underside hindwing with highly complex, intricate pattern of brown, gray, black and white markings; four prominent black submarginal ocelli corresponding to the upperside.
**Male:** Similar to the female.
**Flight period:** May–August, depending heavily on arrival of seasonal migrants.
**Distribution and Habitat:** Widely distributed in all locations except the Deosai Plains. Found in virtually any habitat type, but most frequently in fields and meadows and around settlements.
**Taxonomy:** Though some subspecies have been described, individuals in this region are typical ssp. *cardui*.
**Comments:** *Cynthia cardui* was first reported in Pakistan by Swinhoe (1887) from Karachi. Leslie and Evans (1903) collected it from Chitral. Rhe-philipe (1917) and Puri (1931) again reported it from Chitral. Menesse (1950) and Malik (1970) reported it from Rawalpindi and Islamabad. Ahsan and Iqbal (1975) reported it from Lahore. Again reported by Iqbal (1978) and Hasan (1994) from Islamabad and other areas, and recently from Gilgit by Hasan (1997). It can be concluded from the current study and these reports that this beautiful species is widely distributed throughout Pakistan. This species is a well-known migrant and is also known to utilize an astonishing diversity of host plants, in 21 genera of plants (Field, 1971), perhaps aiding in its nearly worldwide distribution. It's overwintering status in Pakistan is not well studied, but apparently it does not overwinter at the higher elevations of northern Pakistan, being replenished by seasonal migrants in spring.

## Family **Satyridae** Boisduval, 1833

Small to medium-sized butterflies, usually brownish. Most species are characterized by eye spots on the wings and undersides having a distinct pattern resembling tree bark. The forewing has one or more veins swollen at the base. In the majority of species, sex brands and hair pencils are present in the males on one or both wings. Eyes are often hairy, the palpi more or less flattened laterally and densely covered with hairs. Antenna are delicate and of medium length. Like the Nymphalidae, the forelegs of both males and females lack claws and are useless for walking (this common character is why some authors combine the two families into a single family: the Nymphalidae). Male tarsus with one long segment; female tarsus with five long segments. Two species in two genera were recorded in the study area, at the Deosai Plains. These species area adapted to the cold, barren mountainous habitat.

## Subfamily **Maniolinae** Grote, 1897

## Genus ***Maniola*** Schrank, 1801

This is a Palaearctic genus, consisting of several similar species, all generally brown with a black subapical occellus. One species of this genus was recorded in the study area.

***Maniola pulchra*** (C. & R. Felder, 1867) - Dusky Meadow Brown
**Wingspan:** 40–41mm.
**Female:** Upperside forewing dark orange (brighter than in the male), overlaid with dark brown scales, and the apical ocellus surrounded by paler buffy orange. There is also a second un-pupilled ocellus in the forewing tornal area. The underside hindwing bears a zig-zag line in the discal area as well as traces of a second dark line in the subapical area. The underside forewing ocellus is pupilled with white and ringed with paler buff.
**Male:** Similar to the female but darker overall and with heavier overlay of dark brown scales..

**Flight period:** July–August.
**Distribution and Habitat:** In the study area, only recorded in the Deosai Plains. Found in hilly northern areas of Pakistan and also in the northwest Himalaya (Mani, 1986). Generally not known from plains habitats but is known to occur at high altitudes, such as those at the Deosai Plains, which average 4,116 m. in elevation.
**Taxonomy:** No subspecies have been identified for this study.
**Comments:** Prior to this study, *Maniola pulchra* was not known from Pakistan. It was first discovered by the authors from the study area.

## Subfamily **Pararginae** Tutt, 1896

### Genus ***Pararge*** Hübner, 1819

This is a Palearctic group of several very similar species, all dark brown in appearance, with one subapical occelus on the dorsal forewing and two or more occeli on the dorsal hindwing. There are varying amounts of orange coloration overlaying the brown ground color in each species. One species of this genus was recorded in the study area.

***Pararge menava*** Evans, 1932 - Dark Wall Butterfly
**Wingspan:** 50-60 mm.
**Female:** Wings above dark brown; subapical ocellus in forewing black, white-centered and ringed yellow, hindwing with two ocelli above.
**Male:** Like the female.
**Flight period:** June–July in the study area.
**Distribution and Habitat:** In the study area, only recorded in the Deosai Plains. Found in hilly northern areas of Pakistan and also in the northwest Himalaya (Mani, 1986). Generally not known from plains habitats but is known to occur at high altitudes, such as those at the Deosai Plains, which average 4,116 m. in elevation.
**Taxonomy:** The nominotypical subspecies has been identified for this region. This species is very similar in appearance to *P. schakra* (Kollar, 1844) and *P. maerula* (C. & R. Felder, 1867), neither of which were recorded during this study, but may be confused with these species. These can be distinguished from *P. menava* in that they contain three ocelli on the dorsal hindwing, while *menava* contains only two.
**Comments:** Prior to this study, *Pararge menava* was not known from Pakistan. It was first discovered by the authors from the study area.

## SUMMARY

No butterfly survey work had previously been conducted in Skardu and surrounding region of the Northern Areas of Pakistan. Due to the lack of published information on butterflies in this region, the main aim of this research was to investigate the taxonomy and distribution of butterflies in the study area. New distribution records were established for all of the species listed in this study. Prior to this study, the species *Pontia callidice, Everes argiades, Plebejus argus, Maniola pulchra* and *Pararge menava* had not been previously reported from Pakistan and are established as new national records by the authors of this study. *Zizina otis* was found frequent in the study areas, but is known from only one other location in Pakistan.

Overall species diversity in the study area was found to be very low. This is due to the natural climate, which is generally cold-temperate and arid, and the distinctively central Asian "steppe-like" habitat of the region, which is rather unsupportive of great butterfly diversity. Thus, the lack of butterfly diversity is not entirely due to the climate, but is more directly a result of lower diversity of flora upon which to support greater butterfly diversity. However, some of the recorded species were very numerous in certain areas, especially around areas of cultivation and irrigation. The following species were found in all six of the study locations: *P. rapae*, *P. brassicae*, *C. erate*, *C. fieldii*, *Z. knysna*, *P. argus* and *C. cardui.* These species apparently function as opportunists, benefiting from the activities of humans, though they may have been present prior to human settlement. Certain other species were found in two or three of the study locations, and therefore may have more specific habitat requirements: *L. phlaeas*, *Z. otis*, *E. argiades*, *A. agestis* and *A. cashmirensis*. Four species: *P. charltonius*, *P. callidice*, *M. pulchra* and *P. menava* were

each found in only one of the study areas: the Deosai Plains. These are all high-altitude species and are very habitat specific.

The species recorded in this study have their origins in two primary zoogeographical zones: the Palearctic region to the north and west and the Oriental (variously called Indo-Australian) region to the south and east. Those of the Palearctic region are well-adapted to cold temperate climates in all developmental stages and are primarily overwintering residents. These are: *P. charltonius*, *P. rapae*, *P. brassicae*, *P. callidice*, *C. erate*, *C. fieldii*, *L. phlaeas*, *E. argiades*, *A. agestis*, *P. argus*, *A. cashmirensis*, *M. pulchra* and *P. menava*. These thirteen species comprise 81% of our sample of 16 species. Three of the species in our sample have origins in the Oriental zoogeographic region and comprise 19% of our sample. These include: *Z. knysna*, *Z. otis* and *C. cardui*. The first two species are resident, with only one, *Z. knysna* being known as a permanent breeding resident. The status of *Z. otis* is not entirely clear, as it is generally known from lower elevations in northern Pakistan and thus may be a seasonal (not overwintering) breeding resident. *C. cardui* falls into a special class of its own, in that it manages to overwinter in the adult stage in the warmer region to the south, and immigrates seasonally into the higher, colder reaches of the north. Thus, butterflies in the study area have a predominantly central Asian character, well-adapted to a dry steppe climate and extreme cold temperatures in winter.

## LITERATURE CITED


AHSAN, M. and J. IQBAL. 1975. A contribution to butterflies of Lahore with the addition of new records. Biologia 21(2):143-158.

BINGHAM, C.T. 1905. The fauna of British India including Ceylon and Burma. Butterflies, Vols. 1-2. Taylor and Francis Ltd., London. XV. 528 pp.

DOHERTY, W. 1886. List of Butterflies taken in Kashmir. J. Asiatic Soc. Bengal 55(2-3):103-140.

EVANS, W.H. 1923. The identification of Indian butterflies (Papilionidae, Pieridae). J. Bombay Nat. Hist. Soc. 29:230-260.

_____, 1933. The Butterflies of Balochistan. J. Bombay Nat. Hist. Soc. 36(1):196-209.

FIELD, W.D. 1971. Butterflies of the Genus *Vanessa* and of the Resurrected Genera *Bassaris* and *Cynthia* (Lepidoptera: Nymphalidae). Smithsonian Contributions to Zoology. 84:1-105.

GOODDEN, R. 1977. The Wonderful World of Butterflies and Moths. Hamlyn Pub. Group Ltd., London. 96 pp.

GORBUNOV, P.Y. 2001. The butterflies of Russia: classification, genitalia, keys for identification. Ekaterinburg. 320 pp.

GOVERNMENT of PAKISTAN. 1995. Agricultural Statistics of Pakistan. 1993-94. Ministry of Food, Agriculture and Livestock. Islamabad, Pakistan. 308 pp.

_____. 1988. Pakistan Demographic Survey 1986. Federal Bureau of Statistics. Karachi, Pakistan. xlii + 137 pp.

GREEN, J. and A. HUANG. 1998. Butterflies of South Vancouver Island. Co-op Report. Royal British Columbia Museum. Available online at: http://rbcm1.rcbm.gov.bc.ca/nh_papers/anneh/text/coverpage.html

HASAN, S. A.. 1994. Butterflies of Islamabad and the Murree Hills. Asian Study Group, Islamabad. 68 pp.

_____. 1997. Biogeography and diversity of butterflies of North West Himalaya. In Biodiversity of Pakistan, Editors: S.A. Mufti, C.A. Woods and S.A. Hasan. Pakistan Museum of Natural History, Islamabad and Florida Museum of Natural History, Gainesville. 181-204.

HEPPNER, J. 1998. Classification of Lepidoptera. Part 1 Introduction. Holarctic. Lep. Vol. 5, Supplement 1: 148 pp.

IQBAL, J. 1978. A preliminary report on Butterflies of district Rawalpindi and Islamabad. Biologia 24(2):237-247.

KHAN, M.R., RAFI, M.A., ILYAS, M. and SAFDAR, M. 2000. Distribution and diversity of genus *Papilio.* (Lepidoptera: Papilionidae) in Rawalpindi and Islamabad. Pak. J. Sci. Res. Vol. 52(1-2):1-3.

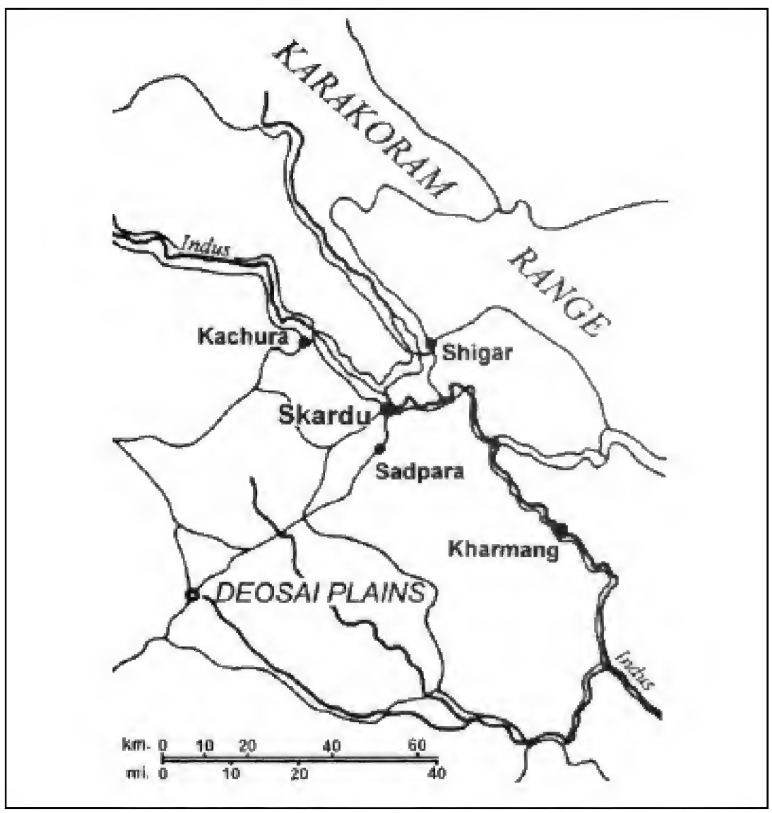
LAFONTAINE, J.D. 1997. Butterflies and Moths. In Smith, I.M. (ed.). Assessment of species diversity in the Mixedwood Plains ecozone. Printed summary [1997]. EMAN Publication. 31 pp. + CDROM.

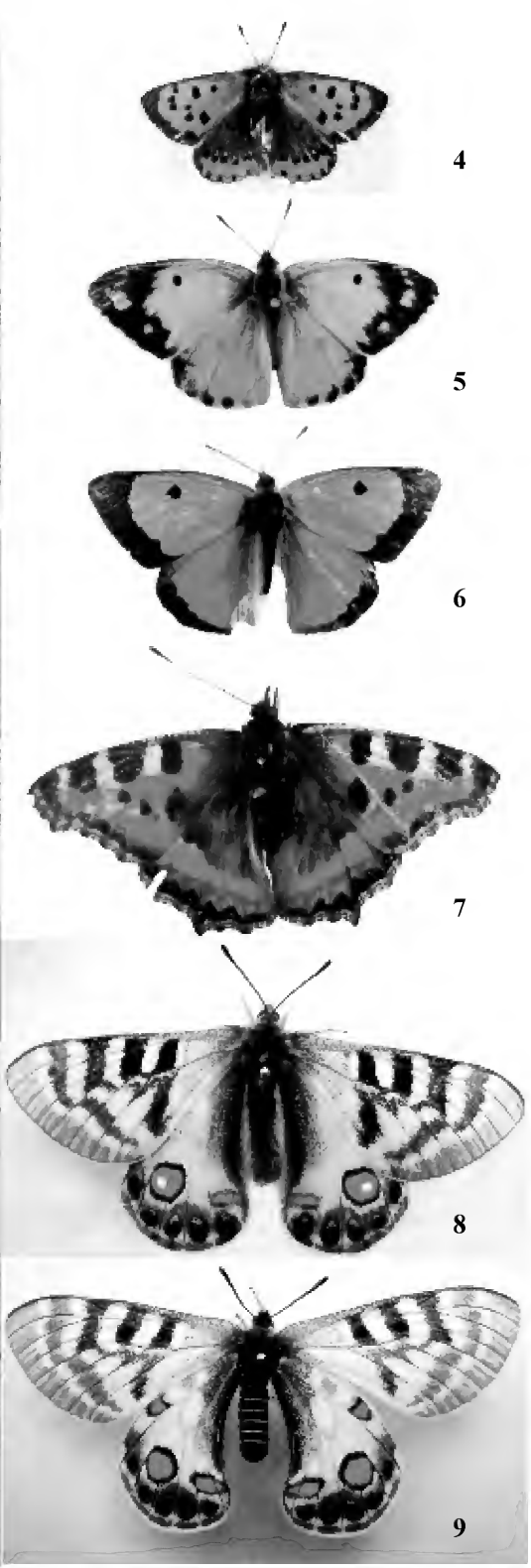
LEFROY, H.M. 1909. The Indian Insect Life. Calcutta, 786 pp.

LESLIE, G.A. and W.H. EVANA. 1903. The Butterflies of Chitral. J. Bombay Nat. Hist. Soc. 14(4):666-678.

MALIK, J.M. 1970. Notes on the Butterflies of Pakistan in the collection of Zoological Survey Department Karachi, Part I. Rec. Zool. Surv. Pakistan 2(2):25-54.

_____. 1973. Notes on the Butterflies of Pakistan in the collection of Zoological Survey Department Karachi. Part II. Rec. Zool. Surv. Pakistan 5(1-2):11-28.
MANI, M.S. 1986. Butterflies of the Himalaya. Oxford and IBH Publishing Co., New Delhi, India. 181 pp.
MARSHAL, G.F.L. and L. de NICEVILLE. 1883-1890. The Butterflies of India, Burma and Ceylon. Vols.1-3, Central Press Co., Calcutta, pp.327, 332, 503.
MENESSE, N.H. 1950. Butterflies of Sind. J. Bombay Nat. Hist. Soc. 49(1):20-24.
PURI, D.R. 1931. Butterflies of Lahore. Govt. College Lahore. 61 pp. Rhe-philipe, G.V.de. 1917. The Butterflies of Lahore. J. Bombay Nat. His. Soc. 25(1):136-142.
RAFI, M.A., M.R. KHAN and M. IRSHAD. 2000. Papilionid (Swallowtails) Butterflies of Pakistan. Islamabad. 33 pp.
SMITH, D.S., and HASAN, S.A. 1997. A preliminary survey of diversity and distribution of butterflies of Northern Pakistan. Gilgit to Khunjerab. In Biodiversity of Pakistan. Editors: S.A. Mufti., C.A. Woods and S.A. Hasan. Pakistan Museum of Natural History, Islamabad and Florida Museum of Natural History, Gainesville. 205-211.
STEWART, R.R. 1982. History and Exploration of Plants in Pakistan and Adjoining Areas. In Nasir, E. and S.I. Ali (ed.). Flora of Pakistan. Published by authors.
STOKOE, W.J. 1974. The Observer's book of Butterflies. W.J. Frederick Warne and Co., London. 191 pp.
SWINHOE, C. 1887. On the Lepidoptera of Karachi and its Neighborhood. J. Bombay Nat. Hist. Soc. 2(1):269-280.
TALBOT, G. 1939. Fauna of British India including Ceylon and Burma. Butterflies #1 and #2. Taylor and Francis Ltd. London. 835 pp.
WHALLEY, P. (1992). Eyewitness Guide of butterflies and Moths. Dorling Kindersley. London. 63 pp.
WYNTER-BLYTH, M.A. (1940-1957). Butterflies of Indian region, 1st Edition. Bombay Nat. Hist. Soc. Bombay. 275 pp.





**Figs. 1-9.** **Fig. 1.** Deosai Plains in summer. **Fig. 2.** Kachura Lake, Skardu Valley. **Fig. 3.** Lake Sadpara, Skardu Valley. **Fig. 4.** *Lycaena phlaeas* (Linnaeus, 1761) - Small Copper, Skardu. **Fig. 5.** *Colias erate* Esper, 1805 - Eastern Pale Clouded Yellow, Skardu. **Fig. 6.** *Colias fieldii* Ménétriés, 1855 - Dark Clouded Yellow, Skardu. **Fig. 7.** *Aglais cashmiriensis* (Kollar, 1844) - Kashmiri Tortoiseshell, Skardu. **Fig. 8.** *Parnassius charltonius* Gray, 1853 - ♂ Regal Apollo, Burzil Top, Deosai Plains. **Fig. 9.** *Parnassius charltonius* ♀ (same data as Fig. 8).